AMH PERMEAMETERS
FOR SOFT MAGNETIC MATERIALS

Characterize rings and strips at high resolution in DC and AC

The AMH Permeameters are automatic measuring systems to characterize rings and strips in DC and AC conditions. Laboratorio Elettrofisico manufactures a complete line of combination permeameters for soft magnetic materials for DC up to 1 MHz.

DC measurement provides analysis for the intrinsic and static properties. The AC measurement offers analysis for the behavior of the materials under dynamic conditions. Dynamic properties are affected by many factors depending on the particular application conditions.

Laboratorio Elettrofisico AC permeameter provides the designer with realistic characteristics of power losses, saturation field and induction performance relating to thickness of the material and the electrical resistivity.

KEY BENEFITS

• Remanence Br, coercivity Hc, saturation values Hsat, Bsat, Jsat, cycle area, relative permeability, losses, losses separation, etc.

• **All DC/AC AMH meet the International Standards IEC 60404-4, IEC 60404-2, IEC 60404-6 and ASTM A773**

• Automatic measurement of complete DC or AC hysteresis loop, normal magnetization curve, permeability curve

• The measuring cycle is fully automatic and is controlled by Laboratorio Elettrofisico exclusive software (Neon 1.0), resulting in complete characterization of the material under test

STANDARD CONFIGURATION

The main cabinet containing:
• Fluxmeter
• Arbitrary Function Generator
• Power amplifier
• Fast Acquisition Unit

• Reference sample for day-to-day control
• Dedicated software Neon 1.0
• PC and printer
• Connection tool for ring sample

Laboratorio Elettrofisico offers a wide range of permeameter models for AC/DC measurement for soft magnetic ring -or strips. Listed below in the chart are the various models that describe the performance range.

GENERAL	AMH-1K-S	AMH-200-K-S	AMH-50K-S	AMH-1M-S
Frequency range	DC ÷ 1.2 kHz	DC ÷ 200 kHz	DC ÷ 50 kHz	DC ÷ 1 MHz
Max power	2200 VA peak	2200 VA peak	6600 VA peak	300 VA peak
Measurable materials	Soft Magnetic Materials			
Measurable quantities	Bsat, Jsat, Hsat, Br, Hc, cycle area, μ_{rel}, specific losses P, losses separation			
Measurable shapes	Ring, strip (with optional Epstein frame)			
Sample size Ring	No physical limitation (size affects the max H field)			
Sample size Strip (Epstein)	30 mm x 300 mm (multiple of 4)			
Typical accuracy Ring	Bsat, Br: ±1%; Hsat, Hc: ±1%; μ_r: ±2%; Losses: ±3%			
Typical accuracy Strip	Bsat, Br: ±1%; Hsat, Hc: ±1%; μ_r: ±2%; Losses: ±3%			
Test time	60-180 seconds (typical)			
Operating T range	15÷40 °C			

ACQUISITION UNIT				
ADC Resolution	16 bits	12 bits	12 bits	12 bits
Sampling rate	1.00 MS/s	2 GS/s	2 GS/s	2 GS/s
Max voltage range	± 11 V	± 20 V	± 20 V	±20 V

FUNCTION GENERATOR	
Frequency	1 µHz to 20 MHz (1 µHz resolution) max measuring frequency is limited by acquisition unit
Voltage amplitude	20 mVpp to 20 Vpp (4 digit resolution)
Amplitude resolution	14 bits
THD	0.04%

FLUXMETER	
Model	Digital Flux
Ranges	(1, 2, 5, 10, 20, 50, 100) x 2000 µWb
Resolution	from 1 µWb (range 1) to 100 µWb (range 100)
Accuracy	±0.5%
Drift	Less than 1 digit/minute

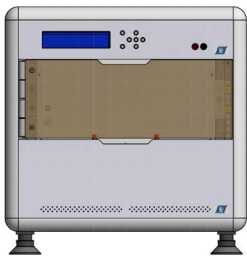| PC AND SOFTWARE	
Operating system	Windows
Software	Neon 1.0 (English or Italian)
Connection	LAN

MAIN CABINET	
Power Supply	220 Vac 50/60 Hz, 16 A absorption, 380 Vac 3 phase + ground, 50/60 Hz, 32 A absorption (AMH-50K-S only)

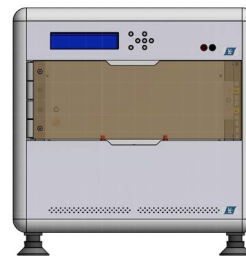| MANUALS AND DOCUMENTATION	Instruction manual (English or Italian)
	Calibration certificate, CE mark

MODEL DIMENSIONS

AMH-1K-S
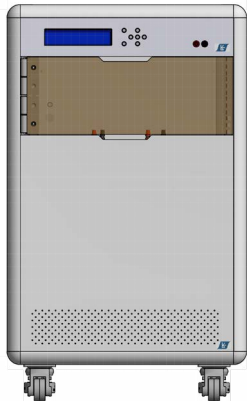L 543 x W 710 x H 556 mm
L 21" x W 28" x H 21.8"

Weight 110 kg - 242 lb

AMH-200K-S
L 543 x W 710 x H 543 mm
L 21" x W 28" x H 21"

Weight 80 kg - 176 lb

AMH-50K-S
L 543 x W 830 x H 889 mm
L 21" x W 32.6" x H 35"

Weight 160 kg - 352 lb

AMH-1M-S
L 543 x W 710 x H 514 mm
L 21" x W 28" x H 20"

Weight 50 kg - 110 lb

HOW IT WORKS

The sample has to be prepared winding a primary set of turns N_H (Drive) around the sample for excitation and a secondary set of turns N_B (Sense) to detect the magnetic flux. The H(t) field is determined measuring the current i(t) in the primary winding: $H(t) = N_H \cdot i(t)/\ell$, where ℓ is the magnetic path. The current is measured by measuring the voltage across a low-inductance resistance R (shunt). For DC measurements, B is measured through the flux Φ by use of a fluxmeter, while for AC measurements, the B(t) field is determined by integrating the voltage V(t) from the secondary winding. An Arbitrary Function Generator generates a voltage at the desired frequency that is amplified by a power amplifier to reach a suitable level of excitation current. A general requirement is that B must change as a sinusoidal function with respect to time:

$$B(t) = B_0 \sin(2\pi f \cdot t)$$

Due to the non-linearity of magnetic materials, generally this condition is achieved only by a feedback control by the software, that drives the Arbitrary Function Generator to supply the suitable voltage V(t) to reach the request condition. This feedback can be hidden to non-expert operators, or can be displayed during the measurement, if desired.
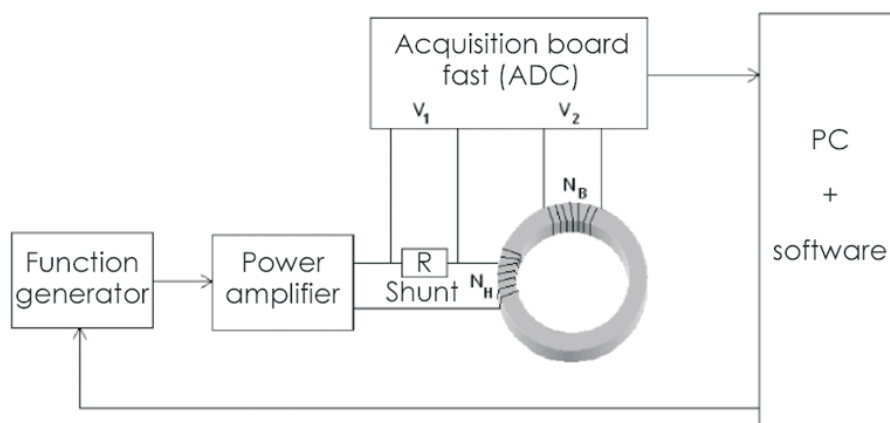
EF-LF-0.4K Epstein Frame Test Set - Low frequencies

The EF-LF Epstein Frame Test Set is a 25 cm Epstein Frame designed for the magnetic characterization of electrical steel strip in accordance with IEC 60404-2, ASTM A343 and A348 test methods. When used in conjunction with one AMH-series, power losses and magnetizing characteristics at commercial frequencies can be measured by the means of a stack of rectangular test specimens.
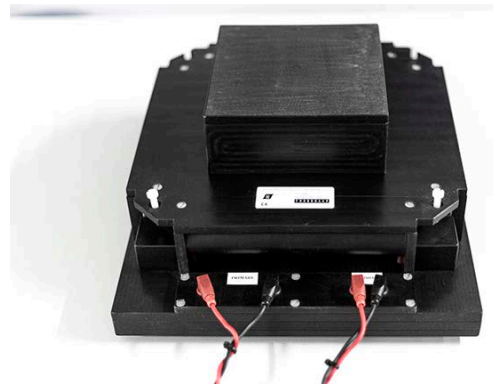
EF-MF-10K Epstein Frame Test Set - Medium frequencies

The EF-MF Epstein Frame is a 25 cm Epstein Frame designed for the magnetic characterization of electrical steel strip in the frequency range 400 Hz to 10 kHz, in accordance with IEC 60404-10 standard. Used in conjunction with one AMH-series, the magnetic characteristics and power losses can be measured by the means of a stack of rectangular test specimens.
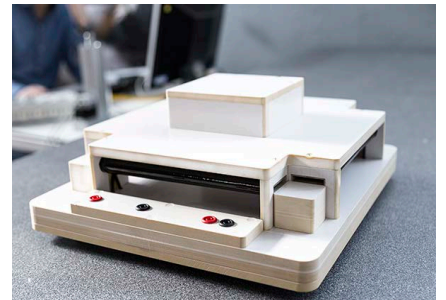
Specifications	EF-LF-0.4K	EF-MF-10K
Frequency range	DC-400 Hz	400-10.000 Hz
Magnetic compensation	Yes	Yes
Maximum current	10 A peak	3 A peak
Maximum H field	7500 A/m (95 Oe)	640 A/m (8 Oe)
Effective length of magnetic path	0,94	0,94
Turns on primary winding N_H	700	200
Turns on secondary winding N_B	700	200
Recommended dimensions of the strips	30 x 280 mm (thickness from 0.05 to 0.5 mm)	30 x 280 mm (thickness from 0.05 to 0.5 mm)
Dimensions of measuring chamber	32 x 10 mm	32 x 5 mm
Overall dimensions	360 x 326 x 166 mm	360 x 326 x 139 mm
Weight	10 kg	7 kg

ST-100 Single Strip Test Fixture

The ST-100 Single Strip Test Fixture is used to characterize the magnetic properties of materials in accordance with ASTM A804 (standard test methods for alternating magnetic properties of materials at power frequencies using sheet type test specifications). The Single Strip Test is a relative test and should be correlated with Epstein Frame data if absolute measurements are required. If the Epstein Frame is used, the strips need to be cut to the required size for the Epstein Frame.
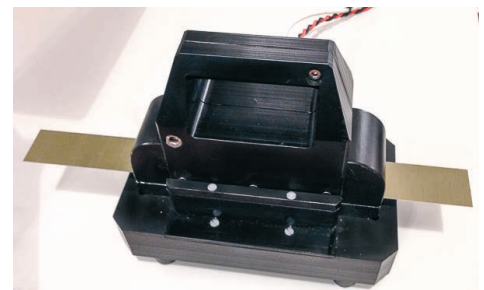
Specifications

|	
Frequency range	DC-400 Hz
Max sample cross section	45 x 0,8 mm
Minimum sample lenght	160 mm
Maximum H field	9000 A/m (110 Oe)
Magnetic compensation	Yes
Overall dimensions	186 x 106 x 162 mm
Weight	5 kg

Module for improved sensitivity

In order to increase the resolution at low field (few A/m) is available a module for improved sensitivity.

RC-50-60-5-LF/HF Ring-coil

Ring coils (RC) are used to measure ring specimens without the necessity to wind turns on them. A ring coil consists basically of an open multipolar connector, in which its pins are connected to give N_H excitation turns and N_B measuring turns when closed. Ring coils are usually tailored on specific sizes, materials, frequencies, levels, since different measuring conditions require different N_H and N_B values. Most of the ring coils can be used in a wide range of measuring conditions. Ring coil contains both primary and secondary windings. The primary winding carries the current to produce the excitation field H. We have available two models of ring coil for measurements at low frequency and high frequency.


Technical Specs

| Model	**RC-50-60-5-LF**	**RC-50-60-5-HF**
min frequency	DC	DC (recom. 1 kHz)
max frequency	1 kHz	20 kHz
min i.d. of sample	49 mm	49 mm
max o.d. of sample	80 mm	80 mm
max height of sample	10 mm	10 mm
Max current	13 A (peak)	13 A (peak)
N_H	28	20
N_B	9	6
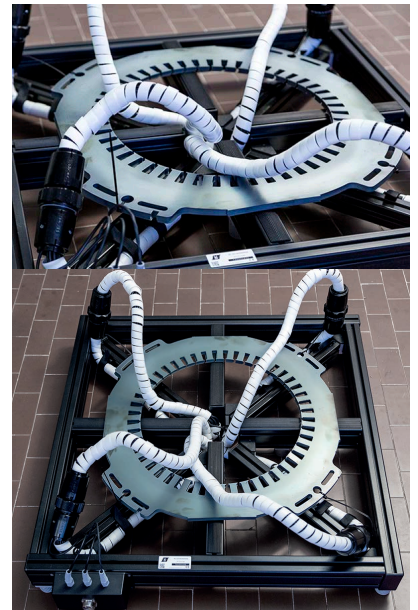
Our proprietary Neon 1.0 software automatically manages measurements for the AMH, including comparison of different curves and statistical analysis. The software helps ensure the measuring process is accurate and absolute and helps prevent improper setting of the sample's parameters.
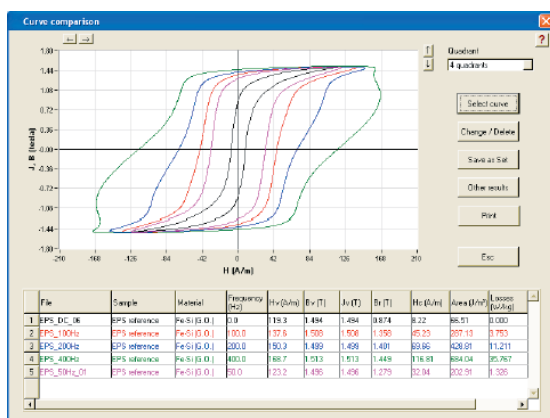
The Automatic Assistant notifies the operator and makes suggestion for the appropriate procedures or settings. The software also provides automatic creation for printing reports, database search feature and curve comparison.
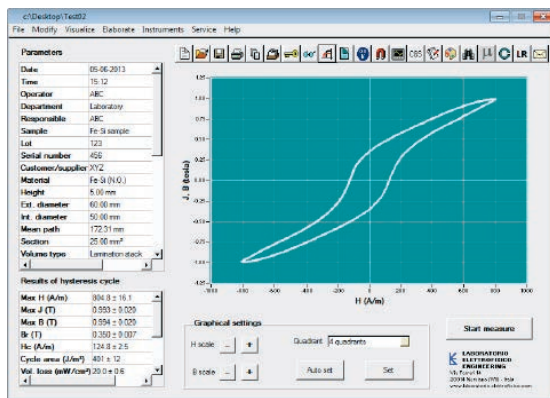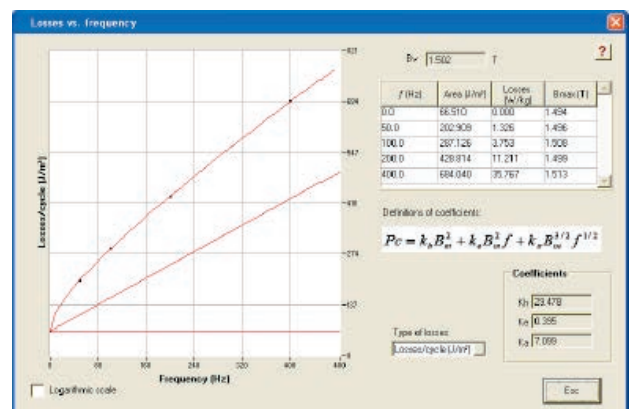

Main panel with example
of measurement (at 50 Hz)
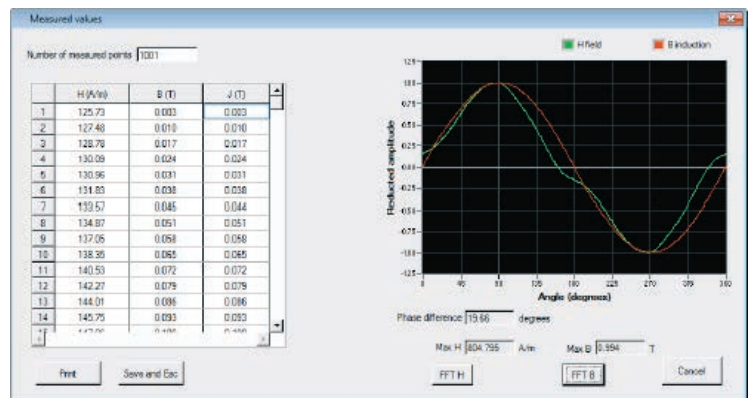
Measured points

Comparison of curves with same Bv at different
frequencies, which allows the user to evaluate
the losses separation and relative coefficients

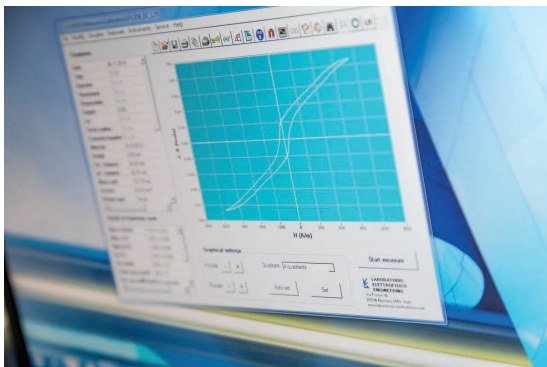Losses separation and relative coefficients

Type of measurement

- Hysteresis loop, normal magnetization curve and relative permeability, in DC and AC conditions
- Sinusoidal B and H condition
- Demagnetization of the sample

Setting of measuring parameters

- Manual or automatic settings of magnetizing and demagnetizing field, speed, resolutions and many other parameters
- Setting of acceptance limit for direct quality control

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

Data elaboration

- Curve comparison
- Curve's interpolation, automatic or using a mathematical function from a list
- Automatic control of the Fluxmeter
- Merging of different curves

Printing a report

- 3 pre-set reports with different sizes and contents
- Customized report option for changing the information and the language between English and Italian
- The report can be opened and saved with other word processor programs, like Microsoft Word™

Data base and file searching

- Data base of measuring files with fast search options, ordering, selection, etc.
- Full compatibility with other spreadsheet programs, such as Microsoft Excel™

Protection

Password protection for restricting access according to selected parameters

Set of measures

Ability to group together different measurements in the same graph. The software recognizes the group type and provides additional results such as losses separation and determination of Steinmetz coefficients

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.
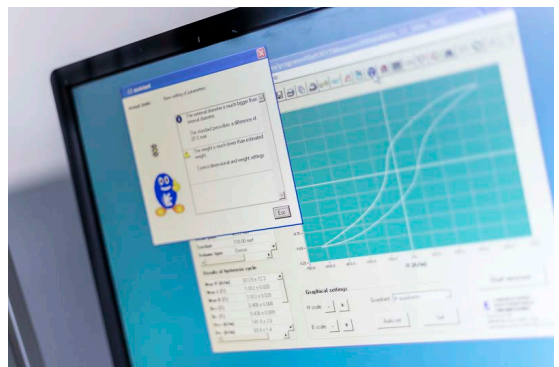
Seamless support

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

CUSTOM
MAGNETIZING FIXTURES

HIGH EFFICIENCY
MAGNETIZERS

MAGNETIZING STATIONS

MAGNETIZING SYSTEMS FOR INDUSTRY 4.0 AND
MEASURING EQUIPMENT FOR ALL MAGNETIC MATERIALS

EUROPE | ITALY (HQ)
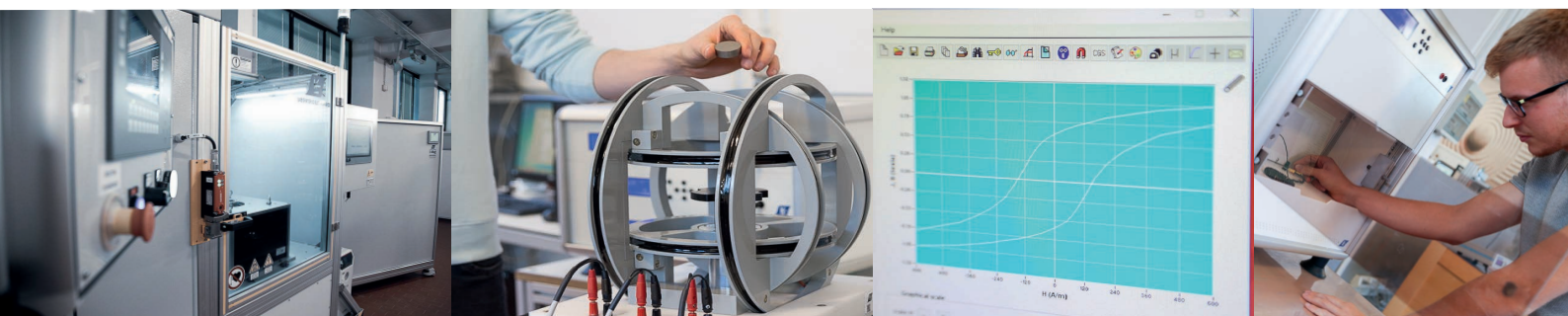Via G. Ferrari 14
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Founded in 1959, Laboratorio Elettrofisico is a global company specializing in the engineering, design, and manufacture of the world's most precise magnetizing and magnetic measuring equipment. Headquartered in Milan, LE has laboratories, testing facilities, support staff, and services centers in the United States, India, and China.

We reserve the right to make changes to these specifications without notice.
For more details, visit: www.laboratorio.elettrofisico.com