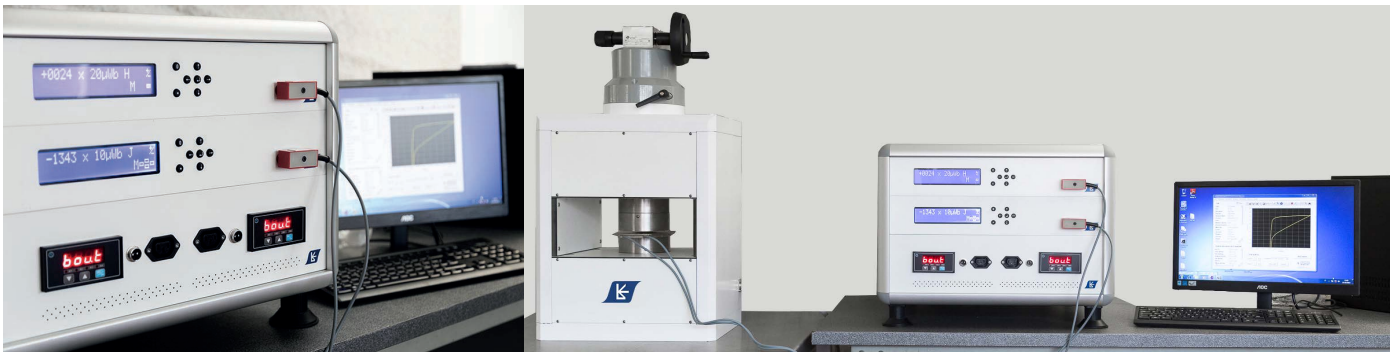
LABORATORIO ELETTROFISICO

AMH-500 - HYSTERESISGRAPH
HARD MAGNETIC MATERIALS



Hysteresisgraph AMH-500 BH-Tracer

AMH-500 Hysteresisgraph is a DC automatic measuring system for characterization of hard magnetic materials, such as Alnico, Ferrite, NdFeB, SmCo and bonded magnets. The AMH-500 meets International Standard IEC 60404-5 and ASTM A977. Measurements are performed at temperature ranging from ambient up to 220°C. Optional temperature pole caps (LPT) enable measurements above 220 °C that meets International Standard IEC/TR 61807.

KEY BENEFITS

- Remanence B_r, coercivity Hc_B, Hc_J, max energy product BHmax, Hknee, recoil permeability (μ_{recoil}), etc.
- Temperature measurements from ambient up to 220 °C
- Automatic measurement of 1st and 2nd quadrant, complete hysteresis loop, recoil line
- Wide range of accessories for any sample shape or size

LATEST IMPROVEMENTS

★ With the NEW additional Iron Cobalt Pole pieces the peak of magnetic field density increases considerably: up to 3.2 T with a 2.5 mm fixed gap

STANDARD CONFIGURATION

- Cabinet containing:
  Fluxmeters, Power supply, Heating unit and Polarity switch
- Electromagnet + pole pieces
- Measuring coil
- Reference sample, for day-to-day control
- Dedicated software Xe-1.0
- PC and printer

TECHNICAL SPECS 1/2

Measurable materials	Alnico, Ferrite, NdFeB, $SmCo_5$, Sm_2Co_{17}, bonded magnets IMPORTANT NOTE: rare earth magnets need to be saturated externally (for ex. with a pulse magnetizer)
Measurable quantities	B_r, Hc_B, Hc_J, BHmax, Hknee, H_A, B_A, μ_{recoil}, Jsat, Hsat, temperature coefficients $\alpha_{Br,}$ α_{HcJ}, load line, working point, squareness, etc.
Accuracy	Br ± 1% Hc_B, Hc_J ± 1.5% BHmax ± 2%
Sample shape	Cylinder, parallelogram, ring, any prism with parallel bases
Sample size	Diameter or diagonal from 3 mm to 82 mm, height from 0.5 to 50 mm
Max H field	Up to 3.2 T (2.560 kA/m) with 40 mm poles at 2.5 mm gap
Testing time	Less than 30 seconds

MAIN ELECTRICAL CABINET

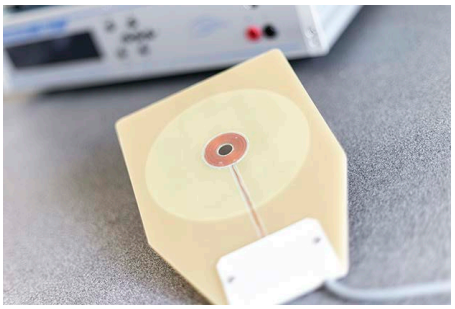
Voltage	220 V (+10%) single-phase + ground, 50-60 Hz, 16 A max
Power	3 kVA
Dimensions	L 543 x W 610 x H 420 mm - L 21” x W 24“ x H 22”
Weight	58.5 kg - 129.3 lb

FLUXMETER DF (2 UNITS)

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
Input impendance	10 kΩ x range

MAGNETIC YOKE LEP/100-4S (see page 7)	
Poles diameter	120 mm - 4.72“
Maximum air gap	80 mm - 3.14”
Max field intensity	see related diagrams, pages 8-9-10
Movement operating	Manual
Poles pieces setting	Micrometric
Dimensions (excluded upper poles adjustment)	330 x 410 x 491 mm - 12.9“ x 16.1” x 19.3“
Weight	350 kg (approx.) - 780 lb
POWER SUPPLY LKW-4-L	
Max Volt-Amp	60 V, 25 A
Power supply	220 V single-phase, 50-60 Hz
Average consumption	1.5 kVA
Dimensions	Rack width 482 mm (19”), h 1U
Communication	RS232
PC AND SOFTWARE	
PC, monitor, printer with all connection cables	Included
Operating system	Windows
Software	Xe-1.0 (English or Italian)
Connection	USB
ACCESSORIES	
Compensated coils	Diameters from 10 to 82 mm
Ferrite arc measurement	Custom
Ferrite powder measurement	Kit with 100 mm diameter
Embedded coils	Coils 10 mm with 80 mm poles pieces
Reference samples	Any material and dimension for all measures for day-to-day control
MANUALS AND DOCUMENTATION	
	Instruction manual includes Hardware Software, Electrical diagrams and maintenance instructions

LJ Compensated coils



To improve accuracy and resolution, our standard LE Compensated coils measure the J-components with less dependency on the H field measurement. A second set of windings are used to measure the H components. Total B field is derived by the software (B=H+J).

Available models:
Model LJX-XX with thickness of 0.5 mm, only for room temperature [R.T] measurements
Model LJA-XX with thickness of 1 mm, only for R.T. measurements
Model LJT-XX with thickness of 2.5 mm. for measurements up to 220 °C

THICKNESS 0,5 mm, TEMPERATURE RANGE 10 ÷ 40 °C

TYPE	DIAMETER	USABLE POLES
LJX-10	10 mm	LP-60
LJX-15	15 mm	LP-60

THICKNESS 1 mm, TEMPERATURE RANGE 10 ÷ 40 °C

TYPE	DIAMETER	USABLE POLES
LJA-05	5 mm	LP-40, 60, 80, 100, 120
LJA-10	10 mm	LP-60, 80, 100, 120
LJA-15	15 mm	LP-60, 80, 100, 120
LJA-26	26 mm	LP-60, 80, 100, 120
LJA-42	42 mm	LP-80, 100, 120
LJA-64	64 mm	LP-100, 120

THICKNESS 2,5 mm, TEMPERATURE RANGE 100 ÷ 220 °C

TYPE	DIAMETER	USABLE POLES
LJT-05	5 mm	LP-40, 60, 80, 100, 120
LJT-10	10 mm	LP-60, 80, 100, 120
LJT-15	15 mm	LP-60, 80, 100, 120
LJT-26	26 mm	LP-60, 80, 100, 120
LJT-42	42 mm	LP-80, 100, 120
LJT-64	64 mm	LP-100, 120
LJT-73	73 mm	LP-120
LJT-82	82 mm	LP-120
LJT-100	100 mm	LP-135

LPH-200 Search coil for H measurements

LPH-200 can be used alone or combined with embedded poles pieces.

Typical magnetic area	7000 mm^2
Stem length	120 mm
Thickness	2.5 mm
Active area (diameter)	10 mm

LP Iron poles - see diagrams at page 8-9

Several models of interchangeable pole pieces are available to ensure the best measurement accuracy. Pure iron pole caps guarantees an uniform field in the gap with a negligible residual field. Pole cap diameters smaller than 120 mm are tapered to concentrate the field produced by the electromagnet.

For example (up to 2.8 T in 2.5 mm gap with LP-60 Pole caps):

TYPE	MAX Ø SAMPLE	USABLE COILS
LP-40	15 mm	5-15
LP-60	26 mm	5-26
LP-80	42 mm	5-42
LP-100	73 mm	5-73
LP-120	82 mm	5-82
LP-135	100 mm	100

See the Electromagnet part page 7.

LPC Iron Cobalt poles - see diagrams at page 10

In order to increase the magnetic field within the gap we have the option to substitute the LP Iron pole pieces with several models of interchangeable iron cobalt (Fe-Co) pole pieces (LPC). For example:

TYPE	MAX Ø SAMPLE	USABLE COILS
LPC-40	15 mm	5-15
LPC-50	26 mm	5-26
LPC-60	26 mm	5-26
LPC-80	42 mm	5-42

LPT Heating poles for high temperature measurements see diagrams at page 11

Heated Pole caps enable measurements above 220 °C, meeting International Standard IEC/TR 61807. Easy connection to the AMH-500 unit and electromagnet.

	LPT-80	LPT-100	LPT 120
Temperature range	20-220 °C	20-220 °C	20-220 °C
Diameter	80 mm	100 mm	120 mm
Uniformity area	45 mm	75 mm	95 mm
Field at 2,5 mm gap	2.4 T	2.2 T	1.9 T
Weight	6 kg	10 kg	13 kg

LP Embedded coils

Pole caps with a magnetic sensor embedded below the surface are available. The embedded coils are useful for large ferrite samples (for example loudspeakers magnet) or for deformable sample (bonded ferrite). These coils are Compensated coils for use with the H sensor, model LPH-200.

TYPE	Ø POLE	Ø COIL	WEIGHT
LP-80/9-9	80 mm	10 mm	6 kg

Shaped poles for ferrite arc magnets

Shaped pole pieces enable the non-destructive quality control of arc-shaped ferrite magnets. This eliminates the difficult task of cutting a regular-size sample from a fragile arc. The B measurement is performed by the coils wound around the pole piece, while the H measurement is performed by the sensor LPH-200. The curvature of arc magnets can vary depending on the application, Laboratorio Elettrofisico can provide custom pole pieces to conform your arc shapes. The measurement is processed within a fixed gap without using a closed circuit set up. This configuration emulates the performance of the magnet in the final application (typically electric motors).

It's no longer necessary to cut measurement material samples from ARC shaped magnets.

Kit for ferrite powders measurements

The kit allows the measurement of ferrite magnetic powder at different pressures and densities. The powder is packed in a small case, pressed by accessories having different thicknesses. The various thicknesses result in different pressures and densities for the powder. The software Xe-1.0 records that data to enable the evaluation of the magnetic properties vs. density. Additional accessories need compensated coil LJT-26 or LJA-26.

HYS Reference samples

Reference samples are used for the day-to-day control of the Hysteresisgraph calibration. They can be used to validate other measuring systems. Reference samples are included with AMH-500 or available on demand in any size and material.

MODEL	MATERIAL
HYS-F	Ferrite
HYS-Nd	NdFeB
HYS-Al	Alnico
HYS-Sm	SmCo
HYS-Ni	Nickel

ELECTROMAGNET LEP/100-4S

The Laboratorio Elettrofisico electromagnet model LEP/100-4S is used in all AMH Hysteresisgraphs, for the measurement of hard magnetic materials and cemented carbides.
The model LEP/100-4S is a vertically oriented electromagnet fitted with a 120 mm diameter precision pole piece and with a continuously adjustable upper pole. This allows variation of the air gap from zero to 80 mm for maximum versatility. The pole piece is locked in place by a socket head screw located on the top portion of the yoke frame. Its special design enables to use the electromagnet without any cooling for a moderate working power level. The coils can be electrically connected to any DC power source.

A set of tapered pole pieces with various diameter allows different combinations of field amplification and uniformity: LP-40, LP-60, LP-80, LP-100, LP-120 (number indicates the pole's diameter, in mm). Special temperature poles are also available. They provide a heating surface for experiments and measurements at temperatures up to 220 °C.

Available poles

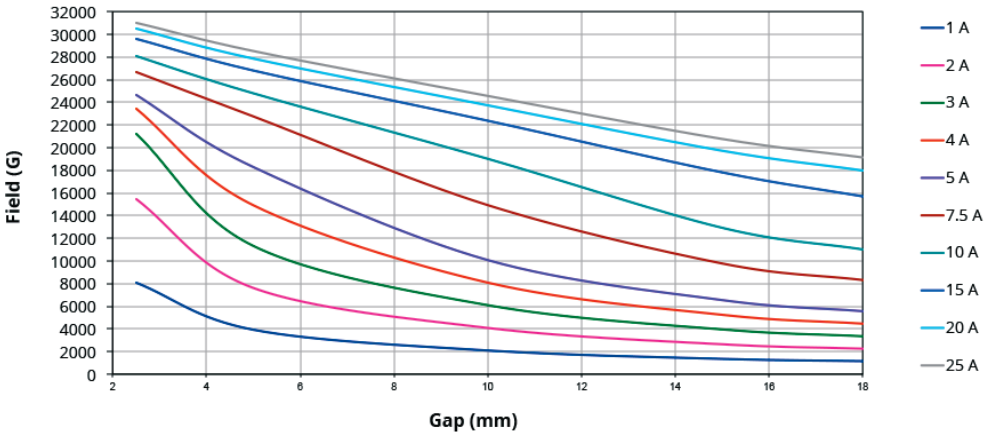
IRON POLES	IRON COBALT POLES	HEATING POLES	EMBEDDED COILS
LP-40	LPC-40	LPT-80	LP80/9-9
LP-60	LPC-50	LPT-100	
LP-80	LPC-60	LPT-120	
LP-100	LPC-80		
LP-120			
LP-135			

ELECTROMAGNET TECHNICAL SPECS

Shaft's diameter	120 mm - 4.72"
Coil's resistance (two coils)	2.4 Ω
Max excursion (without poles)	80 mm - 3.15"
Cooling	Static air
Max current	25 A
Lock	Included
External dimensions	328 x 388 x 491 mm - 12.9" x 15.3" x 19.3"
Intercoil spacing	135 mm - 5.31"
Weight	330 kg - 726 lb

FIELD DIAGRAMS - IRON POLES (LP)1/2

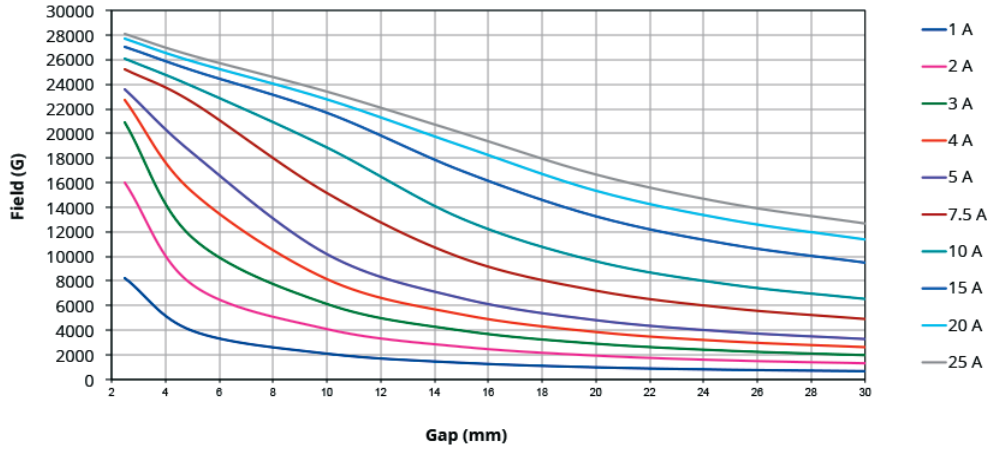
LP-40



POLES LP-40

Diameter	40 mm
Gap adjustment	0-25 mm
Current 25 A:	
H @ 2.5 mm	3.10 T
H @ 5 mm	2.85 T
H @ 15 mm	2.08 T

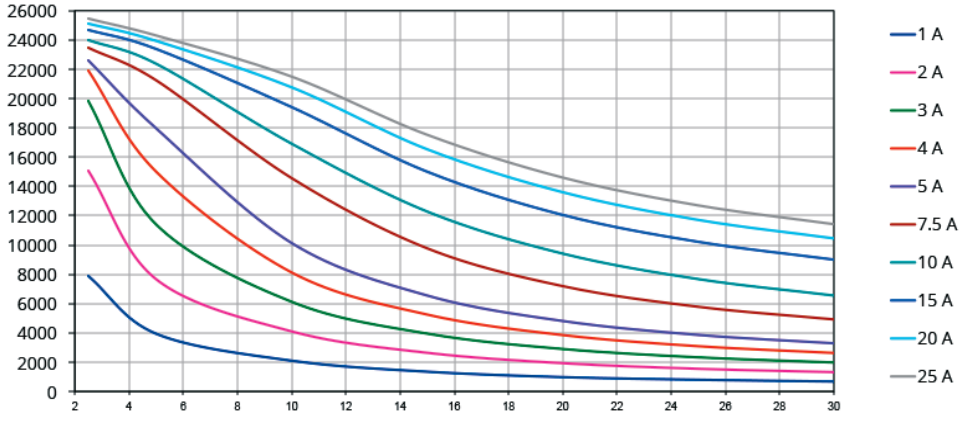
LP-60



POLES LP-60

Diameter	60 mm
Gap adjustment	0-30 mm
Current 25 A:	
H @ 5 mm	2.63 T
H @ 10 mm	2.34 T
H @ 20 mm	1.67 T

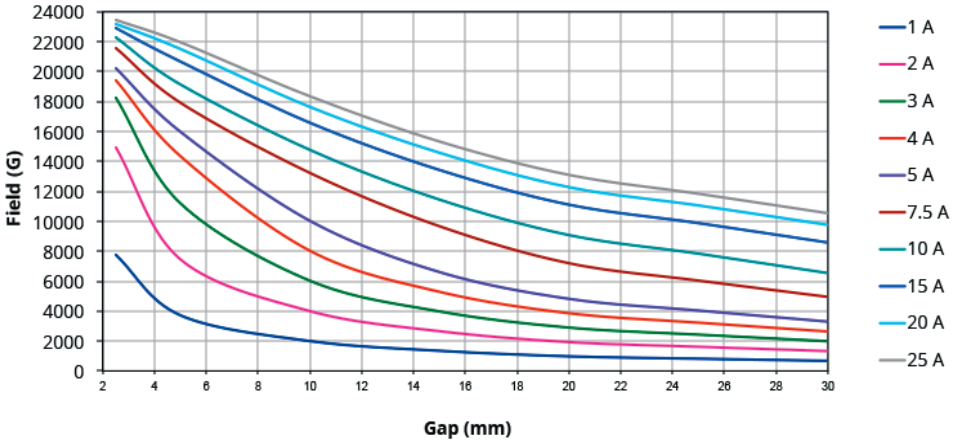
LP-80



POLES LP-80

Diameter	80 mm
Gap adjustment	0-50 mm
Current 25 A:	
H @ 5 mm	2.43 T
H @ 10 mm	2.15 T
H @ 20 mm	1.46 T

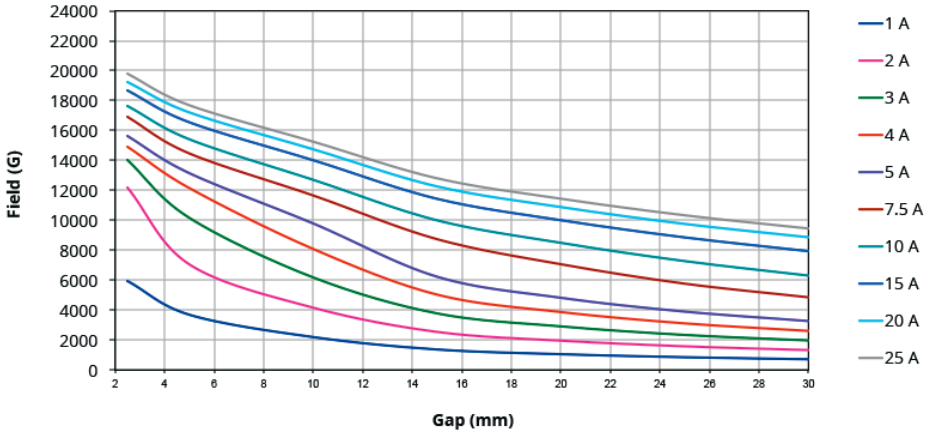
LP-100



POLES LP-100

Diameter	100 mm
Gap adjustment	0-60 mm
Current 25 A:	
H @ 5 mm	2.20 T
H @ 10 mm	1.84 T
H @ 20 mm	1.31 T

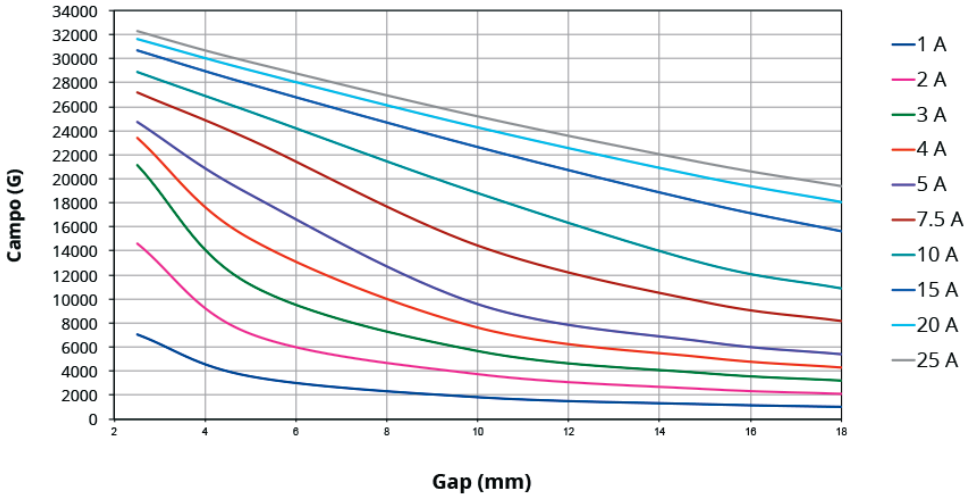
LP-120



POLES LP-120

Diameter	120 mm
Gap adjustment	0-60 mm
Current 25 A:	
H @ 5 mm	1.77 T
H @ 10 mm	1.52 T
H @ 20 mm	1.14 T

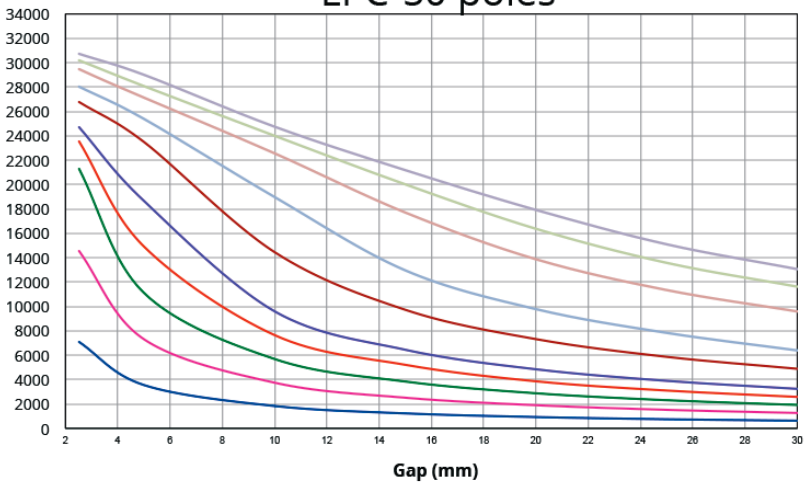
LPC-40 poles



★ POLES LPC-40

Diameter	40 mm
Gap adjustment	0-25 mm
Current 25 A:	
H @ 2.5 mm	**3.22 T**
H @ 5 mm	2.97 T
H @ 15 mm	2.13 T

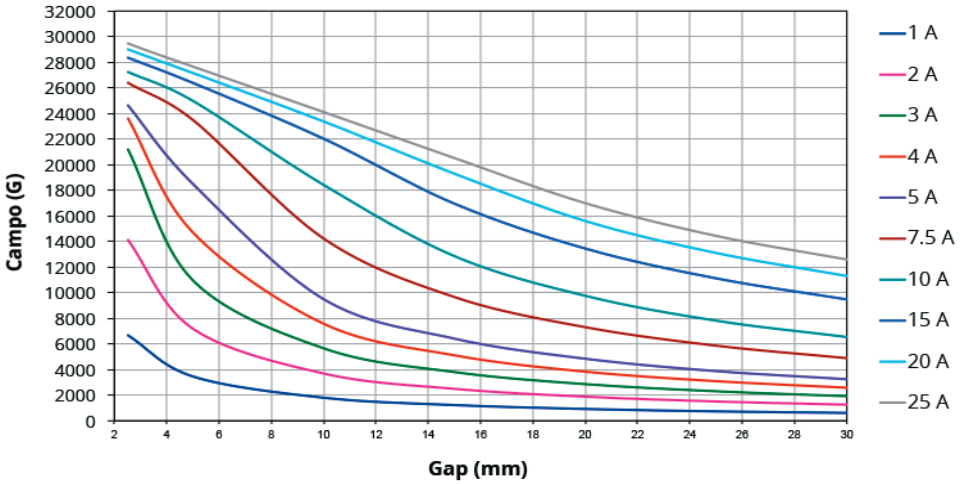
LPC-50 poles



POLES LPC-50

Diameter	50 mm
Gap adjustment	0-30 mm
Current 25 A:	
H @ 5 mm	2.9 T
H @ 10 mm	2.47 T
H @ 20 mm	1.79 T

LPC-60 poles

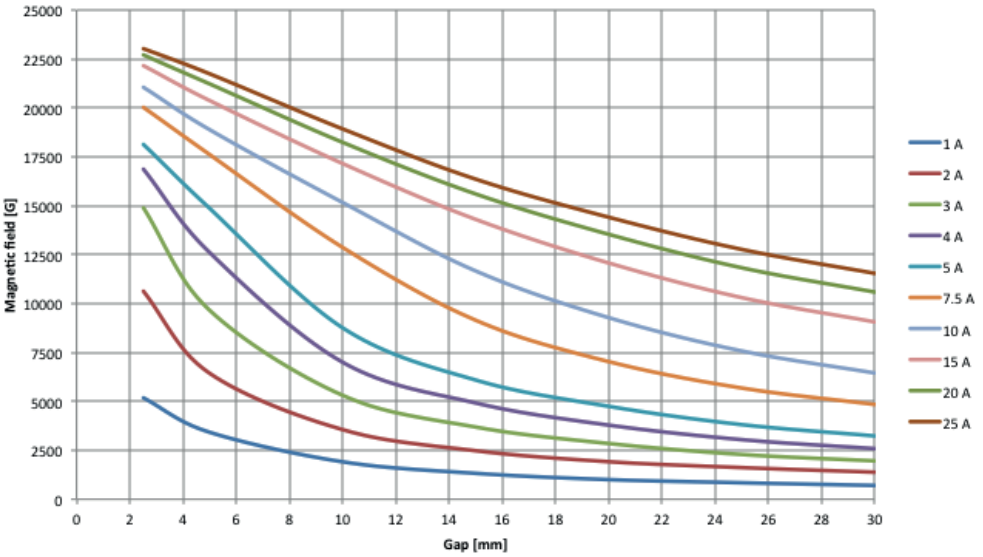


POLES LPC-60

Diameter	60 mm
Gap adjustment	0-30 mm
Current 25 A:	
H @ 5 mm	2.77 T
H @ 10 mm	2.41 T
H @ 20 mm	1.70 T

FIELD DIAGRAMS - HEATING POLES (LPT)

LPT-80 poles



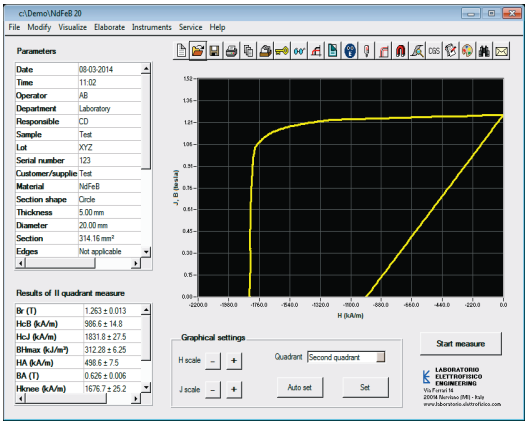
POLES LPT-80

Diameter	80 mm
Gap adjustment	0-50 mm
Current 25 A:	
H @ 5 mm	2.17 T
H @ 10 mm	1.89 T
H @ 20 mm	1.44 T

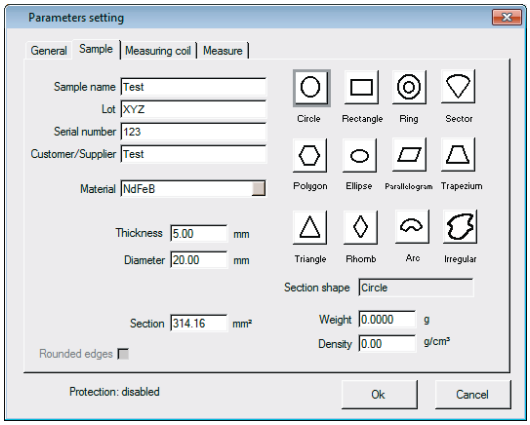
Xe-1.0 SOFTWARE

Xe-1.0 is a powerful software to manage automatically the measurement and to provide additional help to overcome several physical limitations; extrapolation of the curve at higher or lower temperatures, interpolation of the curve when incomplete or irregular, curve's completion for high-coercivity magnets, etc.

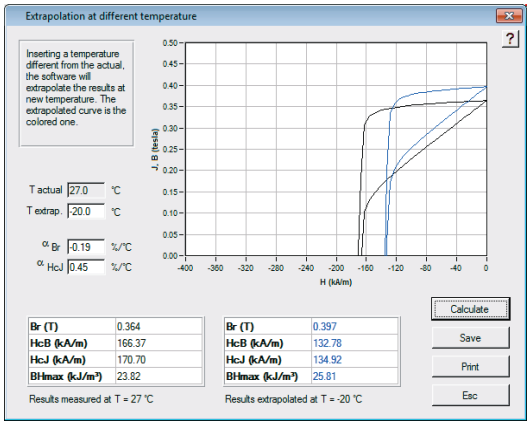
This operating software maintains the overall accuracy controlling all the parameters to ensure the measurement is precise and to prevent operating errors.



Set of curves at different temperature and thermal coefficient evaluation



Parameters set, results and graph



Curve extrapolation at a lower or higher temperature to evaluate the temperature behaviour of the magnet without making the measurement at high or low T

FEATURES

Type of measurement

- 1st quadrant, 2nd quadrant, 1st and 2nd quadrant
- Complete hysteresis cycle
- Recoil permeability

Setting of measuring parameters

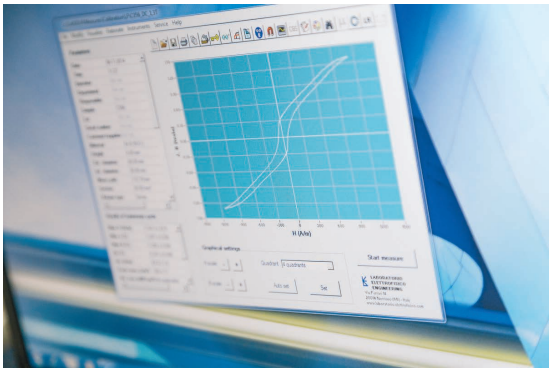
- Manual or automatic settings of magnetizing and demagnetizing field, speed, resolutions and many other parameters
- Setting of thresholds for direct quality control

Results

- Br, Hc_J, Hc_B, BHmax, BA
- HA, HKnee, Hsat Jsat, Bsat, recoil permeability, magnetic moment, anisotropy parameters, load line, working point, temperature in °C and °F
- Magnetic units in SI and CGS, measures in mm and inches, temperature in °C and °F

Data processing

- Curve comparison
- Curve extrapolation at higher or lower temperature, for a quick evaluation of the measured curve at different T
- Curve's interpolation, automatic or using a mathematical function from a list
- Extrapolation of uncompleted curves (high-HcJ materials)
- Correction of pole pieces' saturation
- Processing of curves made with shaped poles
- Automatic control of the Fluxmeter's drift



Printing a report

- 6 pre-set reports with different sizes and contents
- Customized report option for changing the information and the language: 10 languages available for printing (European languages + Chinese & Hindi)
- Direct print or automatic creation of graphical and/or text file
- Reports can be edited

Data base and file searching

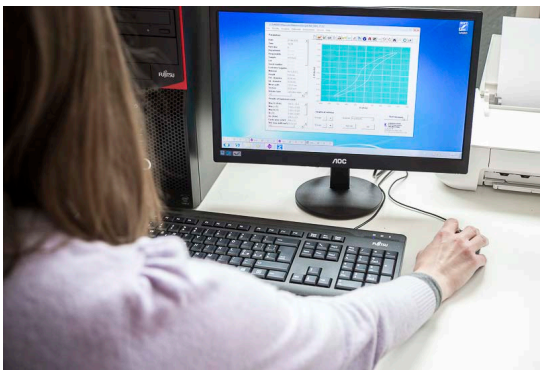
- Data base with fast search options, sorting, selection, etc.
- Full compatibility with other spreadsheet programs, such as Microsoft Excel™

Protection

Password protection for restricting access according to selected parameters

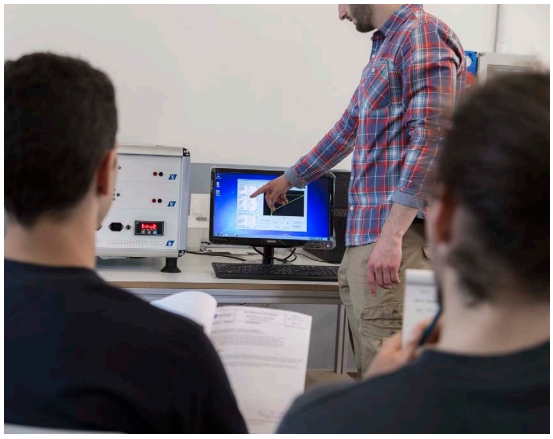
Set of measurements

Ability to plot together different measurements within the same graph. The software recognizes the group type and provides additional results such as temperature coefficient or some statistical data (average, standard deviation, etc.).



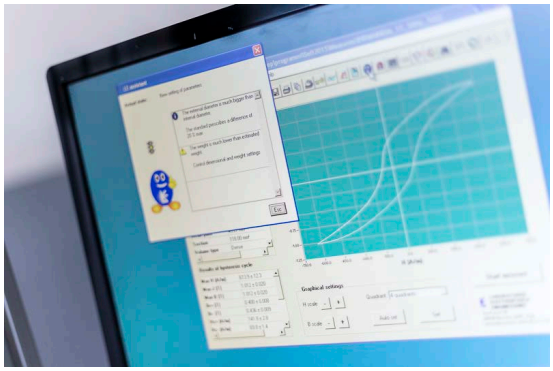
Personalized training

Rely on our team of experts for personal training during the acceptance period at Laboratorio Elettrofisico. After delivery, additional training can 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

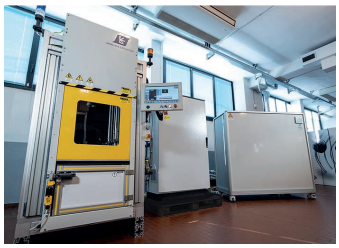
With LE, you're only one button away from expert help. Access online support through TeamViewer screen sharing, Skype us - or send a request for technical assistance directly through your equipment’s software. Seamless support for LE equipment is built in.

LABORATORIO ELETTROFISICO

CUSTOM
MAGNETIZING FIXTURES

HIGH EFFICIENCY
MAGNETIZERS

MAGNETIZING STATIONS



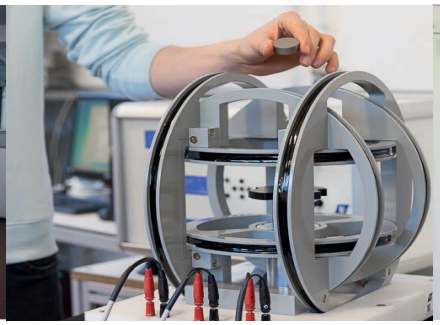
MAGNETIZING SYSTEMS FOR INDUSTRY 4.0 AND MEASURING EQUIPMENT FOR ALL MAGNETIC MATERIALS

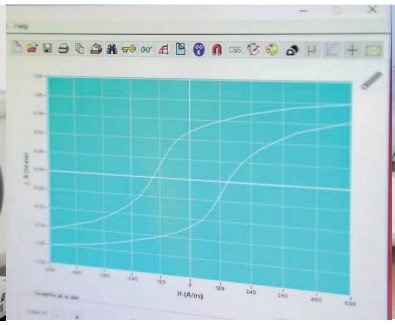
EUROPE | ITALY (HQ)
Via G. Ferrari 14
Nerviano, MI 20014
+39 0331 589785

USA | MICHIGAN
40 Englewood Drive, Suite H
Lake Orion, MI 48359
+1 248 340 7040

CHINA | SHANGHAI
389 Zhao Jia Jing Lu, building 4,
Songjiang Qu, Shanghai Shi, 201613
+86 21 5401 9806

Contact us: sales@elettrofisico.com





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.