

## New competencies at Cedrat Technologies: Magnetic Characterization of Materials.

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Designing a physical model without knowing the behaviour of the materials used. Are you sure to be efficient? CEDRAT TECHNOLOGIES offers you the possibility to:

- Provide you all or part of the data base on the materials' magnetic properties
- Realise the magnetic characterization of your samples

Available magnetic characterization data (in the Figs 1 and 2 you can see some materials listed in our data base).

### Characterization services

For any study of characterization (Fig 3), we take care of:

- The provisioning of materials and their thermal treatments if needed,
- The preparation of material samples (machining in the form of torus or bar),
- The realization of magnetic characterization (first magnetization and quasi-static loop),
- The detailed synthesis of the characterization.

### Measured characteristics

The measured characteristics (Fig 4) are:

- First magnetisation curve, hysteresis loop,
- Remanent flux density, coercive field,
- Relative permeability (mean and max), Saturation of magnetic polarisation.

The table here below summarizes the main measured magnitudes thanks to the first magnetization curve and the quasi-static hysteresis loop of the material.

**Note:** the initial permeability of material can also be measured.

Stainless steel	Structural steel	Pure iron	Alloys	Powders (SMC)
Ferritic : (UGIPERM 12FM,...) Martensitic : (UGITECH 416, ...)	XC18 XC48 ...	ARMCO ...	Iron-Cobalt (AFK502) Iron-Nickel (SUPRA 50)	SOMALOY 500 ...

Figure 1: Some materials listed in our data base.

### Method description & required samples

Magnetic characterization of materials is carried out with an automatic bench, built and computer driven with Labview 7.1 (Figs 7 and 8). In order to define the procedure measurement, the international standard IEC 60404-4 has inspired us.

The characterization (Figs 5 and 6) can be achieved in two ways:

- **Torus method:** we use a ring which is equipped with two windings (field winding and measurement coils) and temperature probe (thermocouple K type).
- **Permeameter method:** we use a bar 150 mm long (max) with a diameter between 10 and 20mm.

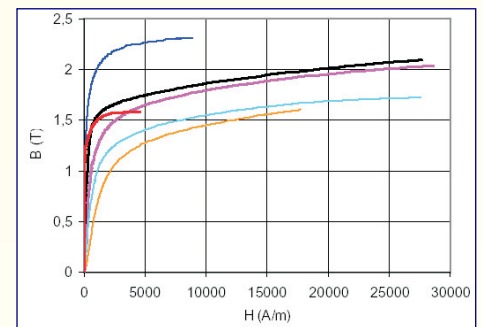


Figure 2: Magnetic flux density curve for several types of soft materials.

Characteristics	
Relative magnetic permeability maximum value ( $\mu_{max}^{(1)}$ )	3439
Relative magnetic permeability mean value ( $\mu_{max}^{(1)}$ )	3123
Saturation magnetic polarization Minimum value ( $J_{s_{min}}^{(1)}$ )	2.06 T
Saturation magnetic polarization Maximum value ( $J_{s_{max}}^{(1)}$ )	2.1 T à 2.15 T
Relative magnetic permeability Equivalent value for modelling ( $\mu_r^{(1)}$ )	3842
Saturation magnetic polarisation Equivalent value for modelling ( $J_s^{(1)}$ )	1.811 T

Figure 3: Characteristics of a magnetic material.

Physical parameters	Symbols	Unit (SI)
Magnetic field	H	A/m
Magnetic induction	B	T
Magnetic polarisation	J	T
Relative permeability	$\mu_r$	

1 <sup>st</sup> magnetization curve	Quasi-static hysteresis loop
B(H)	B(H)
J(H)	J(H)
$\mu_r(H)$	Coercive field : Hc
$\mu_r$ max	Residual induction : Br
Saturation Induction: Js	

Figure 4: Measured characteristics.

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## New competencies at Cedrat Technologies: Magnetic Characterization... (continued)

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### Compatibility with FLUX software

FLUX is a computation software of electric machines and magnetic systems by the finite elements method, (<http://www.cedrat.com/software/Flux/pdf/flux.pdf>) marketed by CEDRAT S.A., MAGSOFT Corp. and their distributors. This software requires input values about the magnetic properties of materials constituting the structure to be modelled.

The characterizations provided by CEDRAT TECHNOLOGIES allow to introduce the properties necessary to take into account magnetic materials into the FLUX models. In particular, the characteristics of initial permeability  $\mu$  and saturation magnetization  $J_{sat}$  allow to feed very easily the model with 2 parameters in Arc tangent Model « $J_{sat\_a\_scal}$ » usually used in FLUX. The exact curve  $B(H)$  can also be completely introduced under FLUX from a file of measured values given in MS Excel format.

Do not hesitate to ask us for the sales conditions to access to our materials data base.

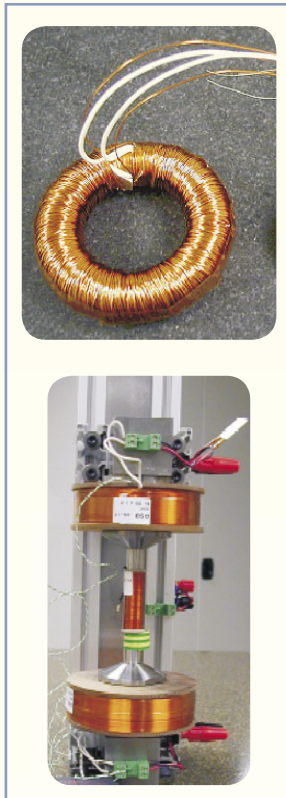


Figure 6: Torus and permeameter methods.



Figure 5: Preparation of raw material UGITECH 416, machining in the form of torus and winding.

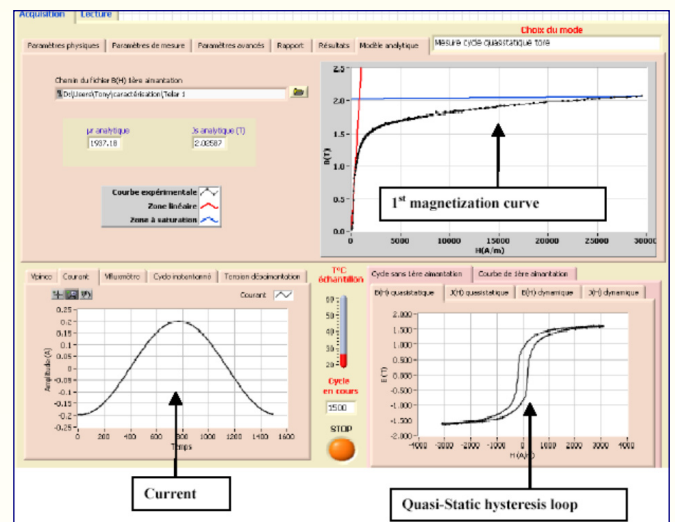


Figure 7: Measures and graphics on Labview interface.

### New linear magnetic actuators catalogue.

CEDRAT TECHNOLOGIES releases a catalogue of new linear magnetic actuators. Please go to the link: [http://www.cedrat.com/engineering/Magnetic\\_&\\_electric\\_devices\\_engineering/Actuators/CEDRAT\\_new\\_magnetic\\_actuators.pdf](http://www.cedrat.com/engineering/Magnetic_&_electric_devices_engineering/Actuators/CEDRAT_new_magnetic_actuators.pdf) and discover some CEDRAT TECHNOLOGIES Design and Innovations.



Figure 8: Set-up for measuring magnetic characterization with Laboratorio Eletrofisico gaussmeter.