

REMAGRAPH® C - 500

for computer controlled measurement
of the hysteresis curves
of soft magnetic materials



● Introduction

The REMAGRAPH® C is a fully automatic, computer controlled station to measure the (quasi-) static hysteresis curves (DC) of soft magnetic materials.

The measurements can be carried out on bars, sheets and rings.

Bars or stripes are clamped together with a measuring coil system between the poles of a double C yoke. The coils are connected to two electronic fluxmeters. The magnetic polarization $J = B - \mu_0 \cdot H$ is measured in dependence of the inner field strength H (initial magnetization curve and hysteresis loop).

Fixed measuring coils are used for various cross sections. Here the air flux between the sample and the coil is compensated in regard to the field strength H . Thus the coils do not have to fit tightly to the surface of the samples and can be used for different cross section shapes. The flux density B is calculated from the polarization so that both $J(H)$ and $B(H)$ curves can be represented. The field strength H is determined by a potential coil fitting tightly to the surface of the sample.

Ring shaped samples are provided with a primary and a secondary winding. The field strength H is calculated from the current in the primary winding. The secondary winding is connected to a fluxmeter for the measurement of the flux density B .

The measuring speed is controlled in a way that the time change of the flux density B remains almost constant. That is why the steep sections of the measuring curve are passed through slowly and the flat ones faster. Thus measuring faults caused by eddy current influences is avoided and the measuring duration is still kept short. So hysteresis losses can be determined independently from eddy current losses.

Special features of the REMAGRAPH® C:

- Automatic measurement of the static hysteresis curves of soft magnetic materials
- Measurements on bar, stripes or ring samples
- The field strength is measured with a potential coil adjacent to the sample



Reg. No. 004201 QM

● Measuring Methods

Depending on the model variation of the REMAGRAPH[®] C - 500 the following measurements are possible:

Measurements on bars or stripes with the measuring yoke MJR 5 as well as with potential coil and compensated surrounding coil.

Measurements on ring samples with windings which are wound on the samples.

Measurements on large sheet samples or on massive parts with an attachment probe.

Measurements of small samples in an open field by using an open field coil with moment measuring coil.

● General Features

Sample dimensions when standard measuring coils are used

Length in field direction at least 90 mm, as well as

- for round bars max. 12 mm \varnothing
- for rectangular bars max. 10 mm · 10 mm
- for stripes max. 40 mm · 5 mm
- Cross section area at least approx. 1 mm²

Field strength in the measuring yoke

0 ... approx. ± 55 kA/m

Measuring duration (adjustable)

about 40 seconds for the complete hysteresis loop, a further 30 seconds for the demagnetization before measurement

Control

PC control via control board ST-P/R2

Standards

IEC 60404-4, DIN EN 60404-4, ASTM A773

● Product Family

The REMAGRAPH[®] C can be composed of various components.

For the measurement of samples like bars, stripes and rings we offer a standard package.

According to the application, other combinations are possible.

Technical details of the components and a list of all available measuring instruments are given on the following pages.

● Description of the Standard package

Components of the REMAGRAPH[®] C – 500:

Cabinet for REMAGRAPH[®] C
Electronic Fluxmeter EF 5 (2 pieces)
REMAGRAPH[®] power supply SVR 4

Electro magnet measuring yoke MJR 5 with exchangeable pole pieces
J-compensated surrounding coil, round JRR
J-compensated surrounding coil, flat JRF
Potential coil PS-R-40/58
Connection box for ring samples CB-R

Computer hardware
Control board ST-P/R2
Software REMA
Installation and training in our premises



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• Technical Data

REMAGRAPH® power supply equipped with a main switch and an automatic circuit breaker. The power supply works with a linear amplifier in four quadrants. A built-in shunt enables a measurement of the current strength. The supply has an overload protection	SVR 4	Maximum voltage : ± 40 V Maximum current : ± 8 A Mains : 230 V, 50-60 Hz Weight : 15 kg
REMAGRAPH® control board Enables the communication between the PC and the power supply	ST-P/R2	Weight : 0.2 kg
Electronic Fluxmeter to measure the flux density B as well as the field strength H (2 pieces needed) with RS 232 interface	EF 5	Detailed technical data and an exact description of the properties of this device can be found on the next page.
Cabinet for REMAGRAPH® C houses above mentioned components incl. wiring		Depth : 610 mm Width : 560 mm Height : 600 mm Weight (empty) : 18.5 kg
Electromagnet measuring yoke for the measurement of bar samples as well as sheet-metal stripes. The measuring yoke is delivered with exchangeable pole caps for different sample shapes. It is connected to the power supply.	MJR 5	Max. measuring field strength : approx. ± 55 kA/m = ± 550 A/cm Weight : 31.5 kg



● Description of Hard- and Software

REMA Software for the REMAGRAPH® C

The magnetic field strength is controlled by the PC via control board ST-P/R2. The field course is regulated so that the time change of the magnetic flux density, dB/dt , is constant. So eddy current effects can be avoided and nevertheless short measuring times are achieved. The measuring values for field strength and polarization are received synchronously from the two fluxmeters and transferred to the computer. The hysteresis loop is directly displayed on the monitor. So the results can already be read during measurement.

The set sample- and measuring-parameters can be stored. Thus in the case of a new measurement only a few new inputs must be made.

The measured results and curves are outputted on the monitor, printer or in result files, which can then be further processed by programs such as Excel etc. This enables a statistical treatment, e.g. of series measurements, over a longer period of time to be carried out.

● Software Features

- User friendly, menu driven operation
- Fast access to important functions via function keys
- Context sensitive help
- Automatic detection of coils and measurement type
- Real time display of the curve during the measurement
- Saving of measuring data and parameters
- Automatic saving (e. g. below a test number)
- Calculation of results
- Print preview
- Output of measuring results and curves on a printer
- Output of measuring results and curves as graphic files (.gif, .jpeg, .bmp) or via the Windows clipboard
- Output of measuring results in files or data bases
- Various possibilities for customer specific output design
- Display of initial magnetization curve and/or hysteresis loop, for $J(H)$ or $B(H)$
- Display of the permeability curve $\mu_r(H)$
- Display of up to 5 curves in one diagram with results
- Language separately selectable for program menus and output (English, German, French, Spanish)
- Microsoft Windows 98/2000/XP compatible

● Parameters

- Default parameters minimize the number of necessary inputs
- Calculation of the cross-sectional area of bars, sheets and rings
- Calculation of the magnetic path length of rings
- Dimensioning help for windings on ring specimens
- Air flux correction, if the measuring turns are not wound directly on the ring



● Demagnetization

- Automatic demagnetization of the samples prior to the measurement
- Adjustable course of the demagnetizing current

● Measurement

- Initial magnetization curve
- Complete hysteresis loop
- Hysteresis loop with preset excitation (H_{\max} or B_{\max}/J_{\max})
- Measurement of ring specimens (B measurement)
- Measurement of bars with circular, rectangular or tubular cross-section with J-compensated surrounding coils
- Measurement with constant speed
- Measurement with controlled speed ($dB/dt = \text{const.}$)

● Evaluation

- Remanence (B_r or J_r)
- Normal or intrinsic coercivity (H_{cJ} or H_{cB})
- Maximum permeability $\mu_{r\max}$
- Maximum field strength and polarization
- Tables of $J(H)$, $B(H)$, $\mu_r(H)$, where H are user defined field strengths. Tables of H values can be predefined.
- Output of sample and measurement parameters and calculated results in ASCII files, for import by other programs
- Output of sample and measurement parameters and calculated results in data bases

● Units

- Full support of SI and CGS units in software and output
- Change of unit system possible at any time
- Simultaneous display of SI and CGS units on diagram axis

CONTROL UNIT

Computer-Hardware for Remagraph[®] C included in standard packages

For the set-up of an automatic measuring system and smooth operation of the before mentioned software the following hardware components are required:

- | | | |
|--|--|--|
| <ul style="list-style-type: none">• Personal computer with<ul style="list-style-type: none">• Hard disk drive• CD/DVD drive• Network connection• LCD flat screen• Keyboard• Mouse | <ul style="list-style-type: none">• Interfaces (2 x COM, USB)• Various connection cables for printer, computer etc. | <ul style="list-style-type: none">• WINDOWS (current version)• HP Deskjet (current model) |
|--|--|--|

The computer has to be configured by Magnet-Physik.

We cannot guarantee faultless operation if apart from the programs loaded by us further software is installed.

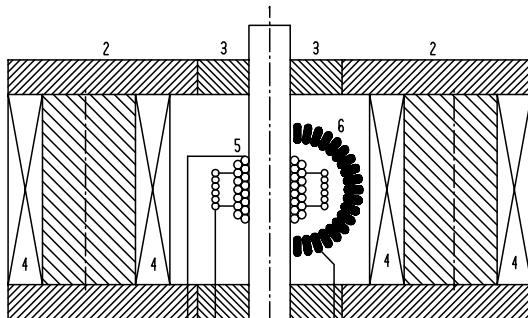
• Electromagnet Measuring Yoke MJR 5



MJR 5



Exchangeable pole pieces



Principle sketch

- 1: Specimen
- 2: Yoke
- 3: Exchangeable pole pieces for bars and sheets
- 4: Field generating coils
- 5: J-compensated surrounding coil
- 6: Potential coil for H measurement
- 7: Connection J-Fluxmeter
- 8: Connection H-Fluxmeter

• Electronic Fluxmeter EF 5



• Description

The Electronic Fluxmeter EF 5 is an electronic integrator of high sensitivity and extremely low drift. Therefore it is used successfully in the magnetic laboratory as well as in the production. A multitude of measuring coils is available and we design coils for special application.

This new device type has all the tested properties of the EF 3 and EF 4 series which have been successfully in use world-wide for the past few years. This new generation of electronic fluxmeters has been developed by using of modern technology. We would like to point out the following specifications:

- microprocessor controlled
- automatic drift compensation and zero reset
- continuously working integrator without measuring ranges
- complete control by menu, the most important functions can be activated by function keys
- memory for coil parameters (measuring coil constants, resistances)
- calculation of measuring values taking into account the probe parameters
- automatic taking over of the coil parameters of measuring coils
- display of the measured value in Volt seconds, Weber or other units according to measuring coils
- EF-5 can be used in systems for automatic measuring and production equipment
- compact design, insertion in 19"- cabinets possible
- modern and attractive design

• Technical Data

Display	:	LCD, 240 x 64 dots	Interfaces	:	RS 232
Display of measured value	:			:	24 V I/O for PLC
Resolution	:	max. 6 digits		:	RS 485 (optional)
Measurements per seconds	:	$10^{-7}/10^{-6}/10^{-5}/10^{-4}$ Vs		:	IEEE 488 (optional)
Input resistance R_i	:	25	Comparator (Limit)	:	4-fold, relay output
Drift	:	0 Ω , 10 k Ω	Peak	:	Max, Min, Max-Min
	:	$<10^{-6}$ Vs/min	Power Supply	:	100/120/220/240 V
	:	($R_i + R_s \geq 10$ k Ω , R_s = coil resistance)		:	± 10 %, 50-60 Hz, 80 W
Max. input voltage	:		Weight	:	approx. 6.2 kg
Analog output	:	60 V	Dimensions	:	
	:	± 10 V, scaling of analog output can be adjusted	Width x Depth x Height	:	484 x 310 x 114 mm ³

• Measuring Accessories for Remagraph® C

Measuring coils

to be used with the measuring yoke MJR 5, for connection to the electronic fluxmeters EF 5:

- **J-compensated surrounding coil, round, type JRR**
to measure the polarization J , for samples up to max. 14 mm \varnothing
- **J-compensated surrounding coil, flat, type JRF**
to measure the polarization J , for samples up to max. 40 mm x 5 mm
- **Potential coil PS-R-40/58**
to measure the inner magnetic field strength H of the specimen



J-compensated surrounding coil JRR (round)



J-compensated surrounding coil JRF (flat)

Further measuring accessories

- **J-compensated surrounding coils**
Round or rectangular, with other dimensions: on request
- **Attachment probe**
25 x 25 x 50 mm
suitable for the recording of hysteresis curves of flat materials (sheets) which cannot be clamped into the measuring yoke MJR 5.

The magnetic flux is measured with a coil that is wound on the yoke of the probe. The magnetic field strength H is obtained from the exciting current. So sheared hysteresis curves are measured. These can be used for comparisons (no absolute measurement of material properties).

The coil consists of a C-shaped yoke of laminated soft steel with two pole faces of each 25 mm x 25 mm with an average distance of 50 mm. It is equipped with a system of exciting and measuring windings. The exciting winding is connected to the power supply, the measuring winding to a fluxmeter.



Potential coil PS-R-40/58

- **Open field coils**
for the measurement of sheared hysteresis loops on small, irregular shaped samples, e.g. parts of relays. The coil systems are manufactured according to the dimensions of the parts to be measured. They consist of a field generating coil and a compensated measuring coil.

• Variants

PERMAGRAPH® – REMAGRAPH® – COMBINATION C – 750

For the measurement of the static hysteresis loops of soft and hard magnetic materials.

The PERMAGRAPH®-REMAGRAPH®-COMBINATION C-750 combines the measuring possibilities of PERMAGRAPH® C and REMAGRAPH® C in one instrument. As some components are only required once, the combination offers a reasonable alternative to separate devices.

Components of the standard package:

Cabinet for PERMAGRAPH®- REMAGRAPH®- COMBINATION C-750

Electronic Fluxmeters EF 5 (2 pieces)

REMAGRAPH® power supply SVR 4

PERMAGRAPH® power supply SVP 2

REMAGRAPH® measuring yoke MJR 5 with exchangeable pole pieces

J- compensated surrounding coil, round JRR

J- compensated surrounding coil, flat JRF

Potential coil PS-R-40/58

Connection box for ring specimens CB-R

PERMAGRAPH® electromagnet EP 2

Pole caps P-0/0 (2 pieces)

J-compensated surrounding coil JH 26-1 (other diameter on request)

Flat pole coil measuring system P-6/6-FeCo

Field measuring coil FS-100/2

Computer-Hardware incl. deskjet printer

Control board ST-P/R2

Software PERMA and REMA

Introduction and training in our works



Cabinet of the PERMAGRAPH® – REMAGRAPH® – COMBINATION C – 750 (with optional temperature control TC 3)

You can find a detailed description of all features of the PERMAGRAPH® C and of the optional accessories in the specification of this instrument.

REMAGRAPH® C – 530

for the measurement of the static hysteresis loops of soft magnetic ring specimens.

If only measurements on rings are required, the REMAGRAPH® C – 530 is a reasonable alternative to a fully equipped REMAGRAPH® C – 500. Measuring yoke and coils are left out. A later extension is possible.

Components of the standard package:

Cabinet for REMAGRAPH® C

Electronic Fluxmeter EF 5 (1 piece)

REMAGRAPH® power supply SVR 4

Connection box for ring specimens CB-R

Computer-Hardware

Control board ST-P/R2

Software REMA



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● Additional Accessories

Reference sample REMAGRAPH®

with measuring diagram and proprietary calibration certificate

Data:

Material	:	St 50
Diameter	:	10 mm
Length	:	90 mm

● Services

Introduction and training

- in our premises -

in the operation of the computer controlled REMAGRAPH® C and its software.

The training will take 1 day and is free of charge.

The customer has to bear all costs in connection with the journey, the stay in Germany, accommodation, food, etc.

Introduction and training

- at customer's works -

in the operation of the computer controlled REMAGRAPH® C and its software.

The training will take 1 day and is at customers' charge.

Additionally the customer has to bear all costs for our employee in connection with the journey (incl. expenses for travelling hours), the stay, accommodation, food, etc.

At least we take the liberty to draw your attention to our gratis booklet

MAGNETIC MEASURING TECHNIQUES

**by Dr. E. Steingroever
and
Dr. Gunnar Ross**

in which you can find more information in connection with the computer controlled REMAGRAPH® C.

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