

## REMAGRAPH<sup>®</sup> C

for computer controlled measurement  
of the static characteristics  
of soft magnetic materials



REMAGRAPH<sup>®</sup> C - 500

### • Introduction

The REMAGRAPH<sup>®</sup> C is an automatic, computer controlled instrument for measuring the (quasi)-static hysteresis loops (DC) of soft magnetic materials.

The REMAGRAPH<sup>®</sup> C - 500 fulfils all requirements of the standard IEC 60404-4. The measurements can be carried out on bars, strips and rings.

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

Preassembled measuring coils are used for various specimen cross sections. The air flux between the specimen and the coil is compensated in regard to the field strength  $H$ . Thus the surrounding coils do not have to fit tightly to the surface of the specimens 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 displayed. The field strength  $H$  is determined by a potential coil fitting tightly to the surface of the specimen.

Ring shaped specimens are equipped 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 to measure the flux density  $B$ .

Besides the classical instrument for bars, strips and rings, further configurations are available, for example instruments for measuring static hysteresis loops with an Epstein frame according to IEC 60404-2.

#### Special features of the REMAGRAPH<sup>®</sup> C - 500:

- Automatic measurement of the static hysteresis loops of soft magnetic materials
- Measurements on ring specimens
- Measurements on bars or strips in a permeameter yoke
- Precise measurement of the field strength  $H$  with a potential coil directly on the specimen surface

## • Measuring Methods

Depending on the model and accessories of the REMAGRAPH® C, the following measurements are possible:

- **Measurements on ring specimens** with windings, which are wound on the specimens
- **Measurements on bars or strips** with the MJR 5 permeameter yoke, potential coil and surrounding coils
- **Measurements with an Epstein frame** on electrical steel strips
- **Measurements on the surface of large sheet specimens or on massive parts** with an attachment probe
- **Measurements of small specimens in an open magnetic circuit** with an open field coil and moment coil

## • Ring Measurements

Specimens	Rings (Rowland rings) or other specimen shapes with a closed magnetic path and constant cross-sectional area
Field strength $H$	Typically up to 10 kA/m (higher field strength are possible, if there is enough winding space and heating of the specimen is avoided)
Standards	IEC 60404-4, DIN EN 60404-4, ASTM A773/A773M

## • Permeameter Measurements

Specimen dimensions for measurements in the MJR 5 permeameter yoke with standard measuring coils	Length in field direction at least 90 mm, and <ul style="list-style-type: none"> <li>▪ for round bars max. 12 mm diameter</li> <li>▪ for rectangular bars max. 10 mm by 10 mm</li> <li>▪ for strips max. 40 mm by max. 5 mm</li> <li>▪ cross-sectional area at least approx. 1 mm<sup>2</sup></li> </ul>
Maximum field strength $H$ in the MJR 5 permeameter yoke	Approx. ±55 kA/m
Standards	IEC 60404-4, DIN EN 60404-4, ASTM A773/A773M The MJR 5 is the IEC Type B permeameter yoke fully compliant to IEC 60404-4.

## • Epstein Measurements

Specimens	Electrical steel strips
Maximum field strength $H$	Approx. 5 kA/m with REMAGRAPH® C - 500/530, approx. 29 kA/m with REMAGRAPH® C - 541
Standards	IEC 60404-2, DIN EN 60404-2, ASTM A773/A773M

## • Product Family

A REMAGRAPH® C can be composed from various components.

For the measurement of specimens like bars, strips and rings, we offer the REMAGRAPH® C - 500.

For special applications, other instrument configurations are possible.

Technical details of the components and a list of available options and accessories are given on the following pages.

## • Content of the Standard Package

### Components of the REMAGRAPH® C - 500:

- Cabinet for REMAGRAPH® C
- 2 Electronic Fluxmeters EF 5
- REMAGRAPH® power amplifier SVR 4
- Permeameter 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
- Computer hardware
- Software REMA
- Installation and training in our premises

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## • Operation

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The REMAGRAPH<sup>®</sup> C is fully computer controlled. The current to magnetize the specimen is supplied by a low noise power amplifier.

The measurement is carried out quasi-statically, which means that the magnetization curve is recorded so slowly that eddy current influences are avoided.

Prior to the measurement, the specimen can be demagnetized. Therefore, an AC magnetic field with decreasing amplitude is generated. Frequency and duration can be preset. Then the measurement course is started with the initial magnetization curve. Excitation is either to the maximum current of the power amplifier or to a preset limit, either for the field strength  $H$  or the polarization  $J$ . Then the measurement goes through the complete hysteresis loop.

In the permeameter yoke MJR 5, the polarization  $J$  is measured with surrounding coils. These are made rugged and can be used for different specimen diameters and geometries. Bars with round, rectangular or tubular cross-sections can be measured in a round surrounding coil. Strips can be measured in a rectangular coil.

The field strength  $H$  is measured with a c-shaped potential coil, which is directly attached to the surface of the specimen. It measures the potential difference between two points on the specimen surface. The field strength is obtained by dividing the potential difference by the distance of the end points of the coil.

The measured values of the field strength  $H$  and polarization  $J$  are received synchronously by the two fluxmeters and transferred to the computer.

Ring specimens or other specimens with a closed magnetic path are equipped with a primary and a secondary winding. The field strength  $H$  is calculated from the current in the primary winding. This current is measured using a precision shunt, an auto-ranging preamplifier and an analog-to-digital converter. The voltage that is induced in the secondary winding is integrated by the fluxmeter to obtain the flux density (induction)  $B$  and the polarization  $J$ .

The hysteresis loop is displayed on the monitor already during the measurement. So results can be seen in real-time.

The measuring speed is usually controlled in a way that the change in time 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, a measuring error caused by eddy current influences is avoided and the measuring duration is still kept short. Therefore, the hysteresis loss can be determined independently from eddy current loss.

The duration of a measurement is adjustable. It is typically about 15 seconds for an initial curve, 60 seconds for a complete hysteresis loop and a further 30 seconds for the demagnetization prior to the measurement.

The specimen, measuring and output parameters can be stored. Thus in the case of new measurements only a few new inputs must be made. This is especially useful for measuring sequences on similar specimens. For successive measurements, the final settings of the last measurement are available as new start settings.

The measured results and curves can be output on the monitor, printer or in result files, which can then be further processed by programs such as Excel, etc. This allows statistical treatments of a series of measurements to be carried out.

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## • Features of REMA – Software for REMAGRAPH<sup>®</sup>

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- Flexible, user friendly operation using menus, function keys, shortcut keys or icons
- Extensive help file, context sensitive help
- Convenient input of measuring parameters
- Saving and opening of parameters and measuring data
- Multiple measurements can be simultaneously open for easy comparison
- Existing measurements can serve as templates for new measurements
- Automatic calculation of measuring results
- Automatic saving of measured data, parameters and results (e.g. under a test name or number)
- Saving of a group of associate measurements into a single file

- Export of measuring data, parameters and results to text files or to Microsoft Excel® files
- Export of parameters and results to text databases or SQL databases, a database viewer is integrated in the software
- Print preview for measuring diagrams with curves, parameters and results
- Output of measuring diagrams to a printer or pdf writer (printer and pdf writer not included)
- Copying of measuring diagrams and result lists via the Windows® clipboard
- Saving measuring diagrams as pictures (bmp, gif, jpeg, png) for easy distribution
- Various possibilities for customer specific output design like selection of curves, calculated results, units, measuring parameters, user-definable information texts, company logo, etc.
- User-definable limit classifiers for all results (out of range results are shown in red or boldface)
- Display of multiple curves in one diagram including results
- Optional display of averaged results of multiple measurements
- Different output diagram layouts can be saved for easy switching between different outputs
- Selectable units for magnetic quantities, temperatures, specimen dimensions and other parameters
- Full support of SI and CGS units in software and output, changing units is possible at any time
- Simultaneous display of results in mixed SI and CGS units can be configured by the user
- The number of significant digits to be displayed for results can be selected by the user
- Creating of result lists for multiple measurements incl. possibility of saving, copying and printing
- Program menu access can be restricted for selected users (password protection)
- Language separately selectable for program menus and output (English, German, French, Spanish, Polish, Czech, Slovak, Russian, Chinese (simplified))
- Microsoft Windows Vista / 7 / 8 / 10 compatible

#### • Parameters

- Default parameters minimize the number of necessary inputs
- Automatic identification of measuring coils and coil data
- Calculation of the cross-sectional area of bars, strips, rings and rectangular cores (e.g. split-tape cores)
- Calculation of the magnetic path length of rings and rectangular cores
- Dimensioning help for windings on ring specimens
- Numerical air flux compensation if the secondary winding is not directly wound onto the specimen
- Possibility of considering the influence of an air gap (sheared hysteresis loop)
- User-extensible data base for data of standard cores, e.g. C-cores
- Automatic use of the standard density of the respective grade for measurements on electrical steel
- Input of room and specimen temperatures in °C, °F or K
- Input of the measurement and specimen identification data in predefined or user-defined text lines
- Extensive parameters verification to avoid illegal or inconsistent settings

#### • Measurement

- Automatic demagnetization of the specimens prior to the measurement
- Adjustable demagnetization parameters (amplitude, frequency, duration)
- Initial magnetization curve
- Complete hysteresis loop
- Commutation curve (normal magnetization curve)
- Excitation to a desired excitation level for the magnetizing current  $I$ , the field strength  $H$  or the flux density  $B$  or polarization  $J$
- Drift correction automatically or on command
- Measurement of ring specimens
- Automatic polarity detection while measuring ring specimens
- Measurement of bars with circular, rectangular or tubular cross-section with J-compensated surrounding coils
- Measurement of electrical steel strips with an Epstein-Frame
- Measurement with constant speed ( $dI/dt = \text{const.}$ )
- Measurement with controlled speed ( $dB/dt = \text{const.}$ )
- Series measurement feature: allows automatically running a sequence of different measurements on the same specimen, for example different excitations or different measuring conditions
- Automatic room temperature recording with optional room temperature sensor

- Automatic specimen temperature recording for ring specimens with optional non-magnetic (T type) thermocouple and optional thermocouple module

## • Evaluation

### Initial magnetization curve

- Permeability curve  $\mu(H)$  (calculated from the initial magnetization curve)
- Permeability curve  $\mu(B)$
- Maximum permeability  $\mu_{\max}$  and corresponding field strength  $H(\mu_{\max})$
- Maximum field strength  $H_{\max}$
- Permeability at maximum field strength  $\mu(H_{\max})$
- Extrapolation calculation for the initial permeability  $\mu_i$
- Tables of  $J(H)$ ,  $B(H)$ ,  $\mu(H)$ , where  $H$  are user defined field strengths. Very useful for material definitions in FEM programs.
- Tables of  $H(J)$ ,  $\mu(J)$  where  $J$  are user defined values
- Tables of  $H(B)$ ,  $\mu(B)$ , where  $B$  are user defined values

### Hysteresis Loops

- Remanence ( $B_r$  or  $J_r$ )
- Normal or intrinsic coercivity ( $H_{cB}$  or  $H_{cJ}$ )
- Maximum field strength  $H_{\max}$ , polarization  $J_{\max}$ , flux density  $B_{\max}$
- Verhältnisse  $B_r/J_{\max}$ ,  $B_r/B_{\max}$
- Hysteresis loss density  $W$  (area inside the hysteresis loop)
- Specific hysteresis loss  $W_s$
- Hysteresis core loss or total hysteresis loss  $W_c$
- Symmetry correction
- Temperature correction: conversion of results by means of temperature coefficients of  $B_r$  or  $H_{cJ}$

### Commutation Curve

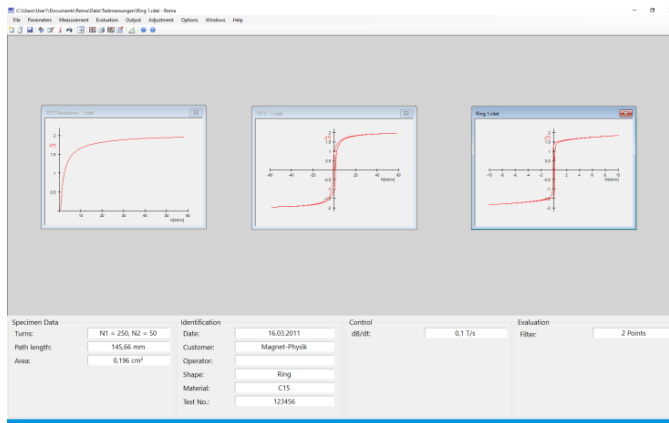
- Commutation curve  $J(H)$  and  $B(H)$
- Amplitude permeability:  $\mu_a(H)$  and  $\mu_a(B)$  curves
- Maximum amplitude permeability  $\mu_{a,\max}$  and corresponding field strength  $H(\mu_{a,\max})$
- Tables of  $J(H)$ ,  $B(H)$ ,  $\mu_a(H)$ , where  $H$  are user defined field strengths
- Tables of  $H(J)$ ,  $\mu_a(J)$ , where  $J$  are user defined values
- Tables of  $H(B)$ ,  $\mu_a(B)$  where  $B$  are user defined values

### General

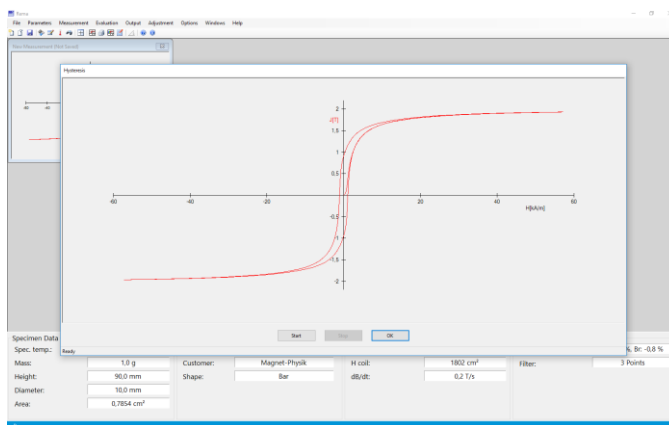
- User values for tables can be predefined and stored. The corresponding functional values are automatically interpolated.
- Output of specimen and measurement parameters and calculated results to ASCII text files, Microsoft Excel<sup>®</sup> worksheets (xlsx) or Microsoft Excel<sup>®</sup> xml spreadsheets
- Output of specimen and measurement parameters and calculated results to databases

Microsoft Excel<sup>®</sup> and a SQL server are not included. Windows 10 normally includes "Microsoft Print to PDF", which allows an automatic creation of PDFs of the measurement diagrams by *REMA*, without further user interaction.

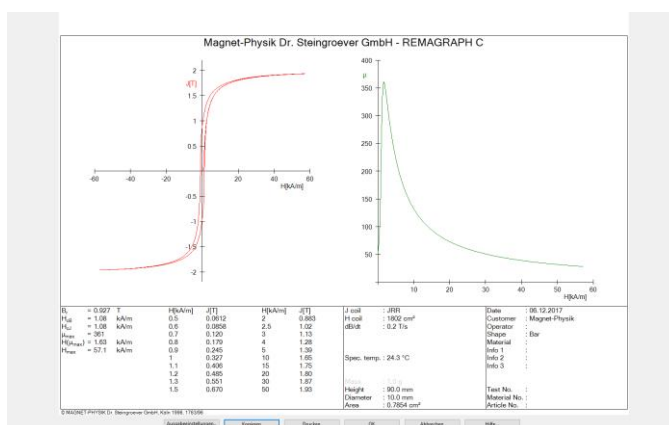
## • Screenshots



Main window with different measurements and measurement parameters



Measurement of an initial magnetization curve and hysteresis loop



Print preview

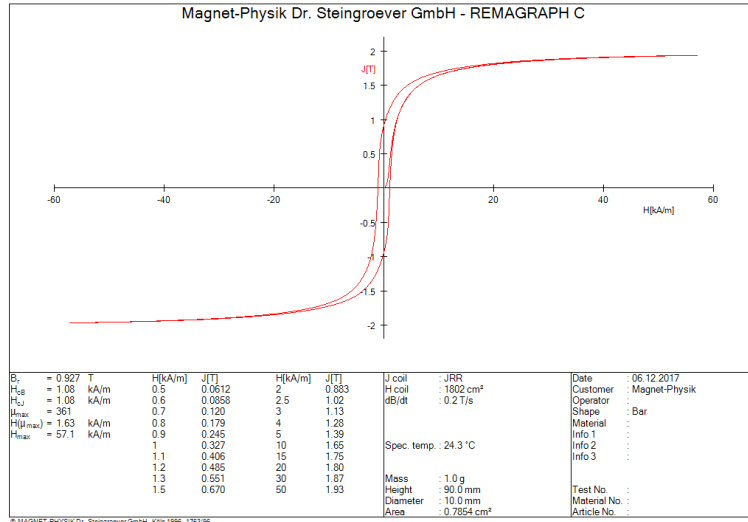
## • Control

Operation of the REMAGRAPH<sup>®</sup> C requires a personal computer to control the measurement course. The computer that is included in the standard packages has the following minimum configuration:

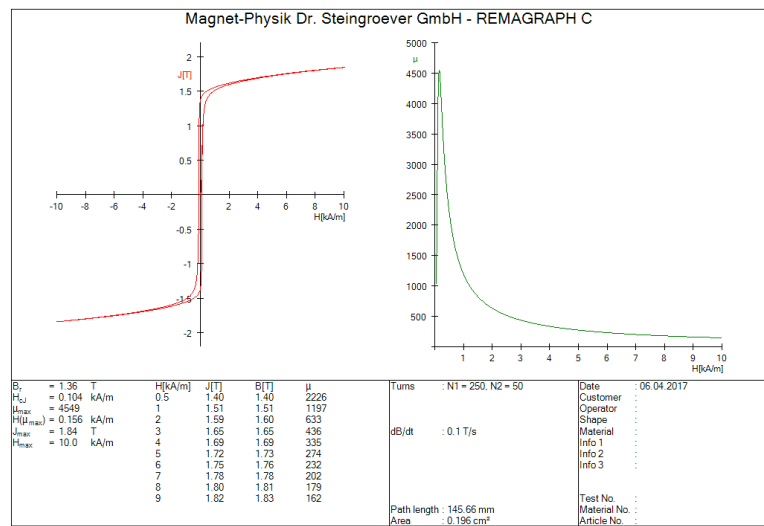
- LCD display
- Keyboard, mouse
- Hard disk drive
- CD/DVD drive
- Network interface
- Interfaces (COM, USB as required)
- Microsoft Windows<sup>®</sup> operating system (current version)

We recommend having the computer configured by Magnet-Physik. We can only guarantee faultless operation if, apart from the programs installed by us or standard office programs, no further software is installed.

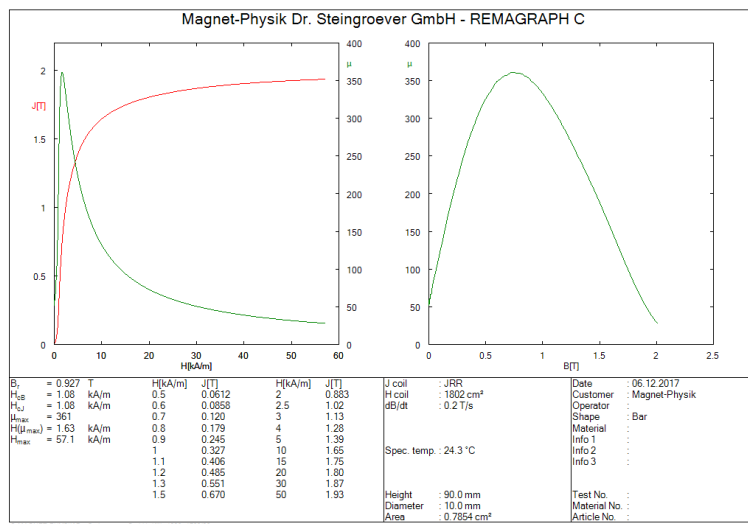
## • Example Diagrams



Initial magnetization curve and  $J(H)$  hysteresis loop of a bar specimen measured in a MJR 5 yoke. The results and information areas of the diagram are user-configurable.



Hysteresis loop and permeability curve  $\mu(H)$  of a ring specimen.



Initial magnetization curve and permeability curves  $\mu(H)$  and  $\mu(B)$



## • Electronic Fluxmeter EF 5



The Electronic Fluxmeter EF 5 is designed to measure the magnetic flux using measuring coils. It comprises a precision digitally compensated DC integrator of high sensitivity and extremely low drift.

For measurements with the REMAGRAPH® C the fluxmeters are completely controlled from the computer. The measuring coils are equipped with electronic memories containing the coil data. In this way, the connected coils can be automatically identified.

The fluxmeters included with the REMAGRAPH® C can also be used for other measurement tasks, for example for testing magnets using a moment measuring coil (Helmholtz coil). For details please consult the data sheets "EF 5" and "Measuring Coils for Fluxmeters".

Key features:

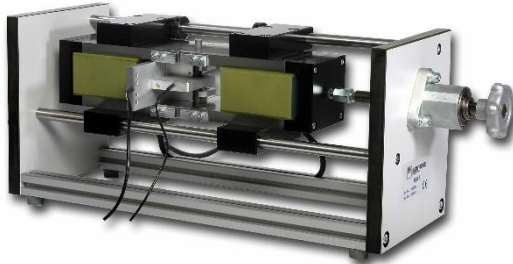
- Microprocessor controlled, easy operation
- Automatic drift correction
- Unique digitally compensated analog integrator: measuring range limits must not be observed
- Self-adjustment by built-in voltage-time reference
- Complete menu control, the most important functions can directly be accessed by function keys
- Automatic calculation of measuring results taking into account the coil parameters
- Directly reading in Volt-Seconds, Weber, Tesla, Gauss or other units
- Automatic coil recognition and instrument configuration for measuring coils with data memories
- 4 limit comparators with relay outputs for process control
- Modern, compact design
- Directly installable to 19" racks

## • Technical Data

Display	backlight LCD, 122 x 41 mm <sup>2</sup>
Reading	max. 6 digits plus 2 digits for exponent
Resolution	$10^{-4} / 10^{-5} / 10^{-6} / 10^{-7}$ Vs
Upper range limits	none due to digitally compensated integrator
Drift per minute	$< 10^{-6}$ Vs ( $R_i + R_s \geq 10$ k $\Omega$ , $R_s$ = meas. coil resistance)
Units (depending on coil type)	Vs, Wb, T, G, Vs/cm <sup>2</sup> , A/m, Oe, Vs cm, A, Vs/n (per turn)
Basic accuracy	0.25 % of reading
Precision (reproducibility)	0.1 % of reading
Input resistances $R_i$	0 $\Omega$ , 10 k $\Omega$
Maximum input voltage	60 V
Measurements per second	25
Trigger	internal, external
Extreme values	Max., Min., Max.-Min.
Analog output	$\pm 10$ V, adjustable scaling
Interfaces	RS232, adjustable baud rate 4800 to 38400 24 V I/O for PLC (reset, drift control, hold reading, trigger, ready) IEEE 488 (optional)
Limit comparator	4 trip points, c-form relay outputs (alternators)



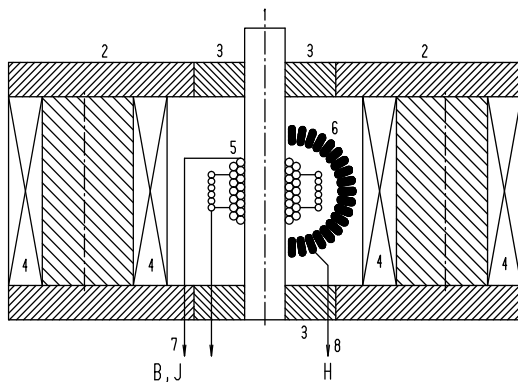
## • Permeameter Yoke MJR 5 for REMAGRAPH® C - 500



**MJR 5**  
Permeameter yoke



**Set of exchangeable pole pieces**



**Schematic drawing**

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

The MJR 5 measuring yoke is the original permeameter yoke that meets the requirements of the international standard IEC 60404-4 exactly (IEC type B permeameter).

The specimen is clamped between the pole pieces of the double-C yoke. The pole pieces are exchangeable to accommodate different specimen shapes. The magnetic field is supplied by two field generating coils.

The length of the specimen in field direction must be 90 mm at minimum. This is necessary to achieve a homogeneous distribution of the magnetic flux over the cross-section of the specimen and to clamp the specimen into the measuring yoke. The specimen cannot be put together from multiple pieces, as also smallest air gaps would cause a shearing of the hysteresis loop. In special cases, specimens of exactly 60 mm length can also be measured.

The cross-sectional area must be constant over the total length and must amount to minimum 1 mm<sup>2</sup>. The following cross-sections are for example suitable:

- Round bars with a diameter up to 12 mm
- Rectangular bars, up to 10 mm by 10 mm
- Strips, up 40 mm wide and up to 5 mm thick

If the specimen is longer than 90 mm, the parts of the specimen outside the yoke do not contribute to the measuring result. Due to the high construction of the MJR 5 which is open at the bottom, rather long specimens can be accommodated without the need of cutting.

The field strength  $H$  is measured using a potential coil (potentiometer coil) PS-R 40/58. This coil ensures a measurement of the field strength  $H$  fully compliant to the requirements of the standard IEC 60404-4.

## • Measuring Coils for REMAGRAPH® C - 500

### Measuring Coils

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

- **J-compensated Surrounding Coil JRR**  
for measuring the polarization  $J$  of specimens up to 12 mm diameter.
- **J-compensated Surrounding Coil JRF**  
for measuring the polarization  $J$  of specimens up to 40 mm x 5 mm.
- **Potential Coil PS-R 40/58**  
for measuring the inner magnetic field strength  $H$  directly on the specimen surface.
- **J-compensated Surrounding Coils**  
with other dimensions, round or rectangular are available on request, for example JRR 26, JRR 32. Measuring coils with diameters of more than 15 mm are only suitable for comparative measurements and not to determine material properties absolutely.

### Further measuring accessories

- **MCE 201 N Epstein Frame**  
Epstein frame for DC measurements and for AC measurements up to 200 Hz. With a power amplifier SVR 4, a maximum field strength  $H$  of approx. 5 kA/m is reached.
- **Open Field Coil**  
for an open-circuit measurement of sheared hysteresis loops on small, irregular shaped specimens, 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 moment measuring coil.
- **Attachment Probe**  
for the recording of hysteresis loops 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 calculated from the excitation current. So sheared hysteresis curves are measured that can be used for comparisons (no absolute measurement of material properties).  
The coil consists of a C-shaped yoke of laminated electrical 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 amplifier, the measuring winding to a fluxmeter.



J-compensated Surrounding Coil JRR (round)



J-compensated Surrounding Coil JRF (flat)



Potential Coil PS-R 40/58  
(Rogowski-Chattock Potentiometer)

## • Options and Special Models

The standard model REMAGRAPH® C - 500 allows measurements on ring specimens as well as on bars and strips in a permeameter yoke MJR 5 with the respective coils. Typical specimens are bars, strips and rings from magnetically soft steel as it is used in valves and relays.

With rings specimens a broader range of materials can be addressed, e.g. rings of electrical steel. For measuring very soft materials like Fe-Ni, amorphous or nanocrystalline alloys, the low current option for the SVR 4 power amplifier is recommended.

### Low Current Option for SVR 4

With this hardware option, the maximum output current of the SVR 4 for measuring ring specimens can be switched between 7.5 A and 0.5 A. Switching is carried out from the REMA software. The low range allows a finer current resolution, which is advantageous for measuring very soft magnetic materials. The resolution in the low range is 0.015 mA instead of 0.23 mA in the high range.

Besides the REMAGRAPH® C - 500, there are further instruments for special measuring tasks:

### REMAGRAPH® C - 530

For measuring static hysteresis loops of soft magnetic *ring specimens*.

If only measurements on ring specimens are required, the REMAGRAPH® C - 530 is a lower priced alternative to a fully equipped REMAGRAPH® C - 500, as the second fluxmeter, the permeameter yoke MJR 5 and the measuring coils are omitted. A later extension is possible. Typical specimens are rings up to approx. 60 mm diameter.

#### Components:

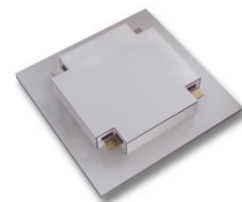
- Cabinet for REMAGRAPH® C - 500 and C - 530
- 1 Electronic Fluxmeter EF 5
- Power amplifier SVR 4 (300 W)
- Connection box for ring specimens CB-R
- Computer-Hardware
- Software REMA

### REMAGRAPH® C - 541

Special device with high output power for measurements with a *Epstein frame* up to a field strength  $H$  of approximately 29 kA/m (365 Oe). The instrument conforms to IEC 60404-2, DIN IEC 60404-2, ASTM A773/A773M.

#### Components:

- Cabinet for REMAGRAPH® C - 541
- 1 Electronic Fluxmeter EF 5
- Power amplifier 1000 W, maximum current approx. 40 A
- Epstein frame MCE 1201 N
- Computer-Hardware
- Software REMA



Epstein Frame

### REMAGRAPH® C - 544

Special device with high output power for measuring hysteresis loops of *large ring specimens*. Typical specimens are rings or split tape cores with diameters of 100 to 300 mm.

#### Components:

- Cabinet for REMAGRAPH® C - 544
- 1 Electronic Fluxmeter EF 5
- Power amplifier 1000 W, maximum current approx. 50 A
- Connection box for the secondary winding
- Computer-Hardware
- Software REMA

## • Optional Accessories

### Reference Specimen for the MJR 5 Permeameter Yoke

Steel bar with measuring diagram and proprietary calibration certificate

Diameter	:	10 mm
Length	:	90 mm

### Reference Ring Specimen

Wound ring-shaped specimen with measuring diagram and proprietary calibration certificate

### Room Temperature Sensor TS-USB

The TS-USB is a temperature sensor for USB connection. Using this sensor the room temperature can be shown on the computer display and automatically be saved with the measurement.



### Thermocouple and USB Thermocouple Module

This set comprises a non-magnetic (T type) thermocouple for measuring the specimen temperature and a thermocouple measuring module that allows connecting the thermocouple to the computer. The temperature is automatically captured by the REMA software and saved with the measurement.

### Oven (Temperature Chamber)

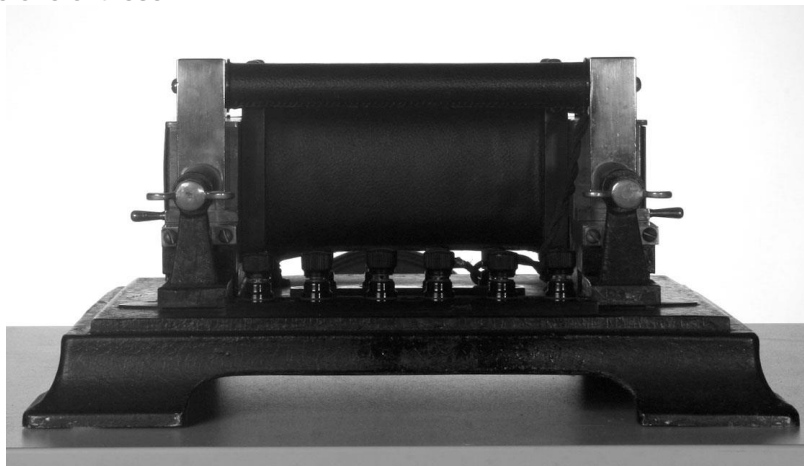
This accessory allows measurements on ring specimens at other temperatures than ambient temperature. The standard model operates from 40 °C to 300 °C. Other temperature ranges are available. The chamber has a feed-through for the specimen wires and thermocouple. A thermocouple for measuring the specimen temperature and a USB thermocouple module are included. The device is remotely controlled from the REMA software. Using the series measurement feature, this allows automatically running a sequence of measurements at different temperatures including a programmable temperature stabilization time prior to the individual measurements.

### Computer Accessories

Computer accessories like a printer, etc. are available on request.

### Retrofit Kit

Do you still have one of these?



If you own a **Fahy Simplex Permeameter** and you want to continue to use it, you can connect it to a REMAGRAPH® C - 500. We can provide the necessary cable set. The REMA software also supports the Fahy permeameter.

## • Combined Instruments

### PERMAGRAPH® - REMAGRAPH® COMBINATION C - 750

This combination instrument allows the measurement of the static hysteresis loops of soft and hard magnetic materials.

It combines the complete measuring capabilities of PERMAGRAPH® C - 300 and REMAGRAPH® C - 500 into one instrument.

As some components are only required once, the combination offers a reasonable alternative to separate instruments.

Components of the standard package:

- Cabinet for combination C - 750
- Electronic Fluxmeters EF 5 (2 instruments)
- REMAGRAPH® power amplifier SVR 4
- PERMAGRAPH® power amplifier SVP 2
- REMAGRAPH® measuring yoke MJR 5 with exchangeable poles
- 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 3
- Pole caps P 0/0 92 mm (2 pieces)
- J-compensated surrounding coil JH 26-1 (other diameter on request)
- Flat measuring pole P 6/6-15
- Field measuring coil FS 100/2
- Computer Hardware
- Control board ST-P/R 2
- Software PERMA and REMA
- Introduction and training in our premises

### PERMAGRAPH® - REMAGRAPH® - REMACOMP® COMBINATION C - 760

This combination instrument allows the measurement of the static hysteresis loops of soft and hard magnetic materials and dynamic (AC) measurements on soft magnetic materials at frequencies up to 19 kHz.

It combines the measuring capabilities of PERMAGRAPH® C - 300, REMAGRAPH® C - 500 and REMACOMP® C - 200 into one instrument.



**Cabinet of PERMAGRAPH® - REMAGRAPH®  
Combination C - 750  
(with optional TC 3 Temperature Control)**

The combination C - 760 comprises all components of the C - 750 but

- Cabinet for C - 760 instead of cabinet for C - 750
- REMACOMP® C - 200 power amplifier 36 V / 12 A instead of power amplifier SVR 4
- Additional REMACOMP® multifunction board
- Software PERMA, REMA and COMP

All accessories of the REMAGRAPH® C can also be used with the combinations.

You can find a detailed description of all features of the PERMAGRAPH® C and REMACOMP® C and of the optional measuring equipment and accessories in the data sheets of these instruments.



## • Combined Instruments

### REMAGRAPH® - REMACOMP® - COMBINATIONS

REMAGRAPH®-REMACOMP® combinations allow testing soft magnetic materials under DC and AC excitation with one instrument.

#### REMAGRAPH® - REMACOMP® Combination C - 703

For measurements on ring specimens,  
including one Electronic Fluxmeter EF 5  
Frequency range : DC, 1 Hz ... 17 kHz in voltage mode  
Power amplifier :  $\pm 20$  V,  $\pm 5$  A

#### REMAGRAPH® - REMACOMP® Combination C - 705

Combination of REMAGRAPHC - 530 and REMACOMPC - 200, for measurements on ring specimens,  
including one Electronic Fluxmeter EF 5  
Frequency range : DC, 1 Hz ... 19 kHz in voltage mode  
Power amplifier :  $\pm 36$  V,  $\pm 12$  A

#### REMAGRAPH® - REMACOMP® Combination C - 710

Combination of REMAGRAPHC - 500 and REMACOMPC - 200, including two Electronic Fluxmeters EF 5, MJR 5 measuring yoke and JRR, JRF, PS-R 40/58 measuring coils  
Frequency range : DC, 1 Hz ... 19 kHz in voltage mode  
Power amplifier :  $\pm 36$  V,  $\pm 12$  A

#### REMAGRAPH® - REMACOMP® Combination C - 1205

Like a REMACOMPC - 1200, with one additional Electronic Fluxmeter EF 5  
Frequency range : DC, 1 Hz ... 20 kHz  
Power amplifier : approx.  $\pm 150$  V,  $\pm 30$  A (load dependent)

The low power REMAGRAPHC - REMACOMPC - Combination C - 703 is especially suitable for measuring ring specimens of Fe-Ni or other magnetically very soft alloys.

The REMAGRAPHC - REMACOMPC - Combination C - 1205 allows, additionally to AC measurements, also DC measurements on electrical steel. Epstein-Frames and Single Sheet or Strip Testers can be used as accessories. For precision DC measurements using an Epstein-Frame, a REMAGRAPHC - 541 is recommended.



**Cabinet of REMAGRAPHC - REMACOMPC - Combination C - 710  
with two electronic fluxmeters EF 5**



## • Technical Data

<b>Electronic Fluxmeter</b> To measure the polarization $J$ and the field strength $H$ where applicable	<b>EF 5</b>	Please find a detailed description on page 8	
		Weight	: 6.3 kg
<b>Permeameter Yoke</b> for measuring bars and strips. The yoke is delivered with a set of exchangeable pole pieces for different specimen shapes. It is connected to a power amplifier SVR 4.	<b>MJR 5</b>	Max. field strength	: approx. $\pm 55$ kA/m (550 A/cm, 700 Oe)
		Weight	: 31.5 kg
<b>Power Amplifier for REMAGRAPH® C - 500 and REMAGRAPH® C - 530</b> The SVR 4 is a digitally controlled four-quadrant linear power amplifier. A built-in precision shunt is used for measuring the current.	<b>SVR 4</b>	Maximum voltage	: approx. $\pm 40$ V
		Maximum current	: approx. $\pm 7.5$ A
		Mains power, standard	: 230 V, 50 Hz - 60 Hz
		Mains power, optional	: 115 V, 50 Hz - 60 Hz
<b>Power Amplifier for REMAGRAPH® C - 541</b> Four-quadrant power amplifier		Weight	: 15.0 kg
		Maximum voltage	: $\pm 25$ V
		Maximum current	: approx. $\pm 40$ A
		Mains power, standard	: 230 V, 50 Hz - 60 Hz
<b>Power Amplifier for REMAGRAPH® C - 544</b> Four-quadrant power amplifier		Mains power, optional	: 115 V, 50 Hz - 60 Hz
		Weight	: 24.1 kg
		Maximum voltage	: $\pm 20$ V
		Maximum current	: approx. $\pm 50$ A
<b>Cabinet for REMAGRAPH® C - 500 and REMAGRAPH® C - 530</b> The cabinet houses the fluxmeter(s), the SVR 4 power amplifier and a mains power switch.		Mains power, standard	: 230 V, 50 Hz - 60 Hz, 6 A
		Mains power, optional	: 115 V, 50 Hz - 60 Hz, 10 A
		Width	: 555 mm
		Height	: 590 mm
<b>Cabinet for REMAGRAPH® C - 541 or REMAGRAPH® C - 544</b> The cabinet houses the fluxmeter, the power amplifier and a distribution unit with mains power switch, measuring and control electronics, precision shunt for current measurement and front panel connections for specimens or fixtures.		Depth	: 600 mm
		Weight, empty*	: 18.5 kg
		Mains power, standard	: 230 V, 50 Hz - 60 Hz, 6 A
		Mains power, optional	: 115 V, 50 Hz - 60 Hz, 15 A
<b>Cabinet for REMAGRAPH® C - 541 or REMAGRAPH® C - 544</b> The cabinet houses the fluxmeter, the power amplifier and a distribution unit with mains power switch, measuring and control electronics, precision shunt for current measurement and front panel connections for specimens or fixtures.		Width	: 520 mm
		Height	: 435 mm
		Depth	: 600 mm
		Weight, empty*	: 20 kg
<b>Cabinet for Combination C - 750 or Combination C - 760</b> The cabinet houses the fluxmeters, the power amplifiers and a distribution unit with mains power switch, measuring and control electronics and front panel connections for specimens or fixtures. A PERMAGRAPH® temperature control can be optionally inserted.		Mains power, standard	: 230 V, 50 Hz - 60 Hz, 6 A
		Mains power, optional	: 115 V, 50 Hz - 60 Hz, 15 A
		Width	: 555 mm
		Height	: 1270 mm
<b>Cabinet for Combinations C - 703, C - 705 or C - 710</b> The cabinet houses the fluxmeter(s), the power amplifier and a distribution unit with mains power switch, measuring and control electronics, precision shunt for current measurement and front panel connections for specimens or fixtures.		Depth	: 600 mm
		Weight, empty*	: 25 kg
		Mains power, standard	: 230 V, 50 Hz - 60 Hz, 6 A
		Mains power, optional	: 115 V, 50 Hz - 60 Hz, 10 A
<b>Cabinet for Combinations C - 703, C - 705 or C - 710</b> The cabinet houses the fluxmeter(s), the power amplifier and a distribution unit with mains power switch, measuring and control electronics, precision shunt for current measurement and front panel connections for specimens or fixtures.		Weight, empty*	: 20 kg
		Mains power, standard	: 230 V, 50 Hz - 60 Hz, 6 A
		Mains power, optional	: 115 V, 50 Hz - 60 Hz, 10 A
		Width	: 520 mm
<b>Cabinet for Combination C - 1205</b> The cabinet houses the fluxmeter whose input is connected to the measuring electronics inside the cabinet, the power amplifier and a distribution unit with mains power switch, measuring and control electronics, precision shunt for current measurement and front panel connections for fixtures.		Height	: 435 mm
		Depth	: 600 mm
		Weight, empty*	: 22 kg
		Mains power:	: 230 V, 50 Hz - 60 Hz, 20 A

\* without fluxmeter(s) and power amplifier

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## • Services

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### **Taking into Operation and Training – at the Premises of Magnet-Physik**

Training in the operation and software of the computer controlled REMAGRAPH®.

The training takes 1 day and is included in the standard packages. The customer bears all costs in connection with the journey, stay, accommodation, etc.

### **Taking into Operation and Training – at the Premises of the Customer**

Training in the operation and software of the computer controlled REMAGRAPH®.

The training takes 1 day and is at the customer's expenses. Additionally the customer bears the costs for our employee in connection with the journey (incl. expenses for travelling hours), stay, accommodation, etc.

Further information, also about the REMAGRAPH® C, can be found in our brochure

### ***MAGNETIC MEASURING TECHNIQUES***

by Dr. E. Steingroever  
and  
Dr. G. Ross

Due to continuous product improvements, specifications are subject to change without notice.

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