Certified acc. to
ISO 9001
Germanischer Lloyd
Certification

FISCHERSCOPE® MMS®

MULTI MEASURING SYSTEM

Order Number:
902-572

Subject to Change

01/99
Version 2.5

FISCHERSCOPE®, MMS®, PERMASCOPE®, ISOSCOPE®, DUALSCOPE®, BETASCOPE®, NICKELSCOPE®, FERITSCOPE®, SIGMASCOPE®, JEWELRING® are registered trademarks of Helmut Fischer GmbH + Co

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1 General Informations

The FISCHERSCOPE® MMS® is a measuring system featuring the following measurement and evaluation capabilities:

Coating Thickness Measurement

Coating thickness measurement according to

- the magnetic induction method
- the eddy current method
- the beta backscatter method

Ferrite Content Measurement

Ferrite content measurement

Electrical Conductivity Measurement

Electrical conductivity measurement

Statistical Evaluation

Statistical Evaluation
various statistical data for process control (SPC), customer specific documentation of the measurement result with user-defined measurement reports

Modular Base Unit

Due to the modular concept of the FISCHERSCOPE® MMS®, only the measuring types ordered by you have been integrated in the base unit. The measuring system can be expanded easily as demands increase. Various transducers can be connected to the base unit (see Chapter 3).

Simple Operation

The measuring system is equipped with a large-area display and a keyboard. Operation is uniform for all test methods employed by the instrument. The menu driven operation prompts the user for all required entries, or for selection of the individual menu functions (measurement applications). Entries are either alphanumeric or by direct selection.

Two Operating Modes

Depending on the application, operation of the MMS® can be limited to the measurement function only. Set-up operations in menu functions, such as defining an application, etc. or setting parameters are not available in this so-called simple operating mode. Measurements can be made only in existing applications according to previously defined settings. This simple operating mode features only one type of measurement presentation. 📖 See Chapters 4 and 5 for further information.

1.1 Structure of the Operator Manual

- Chapters 1 through 7 cover all measuring types of the FISCHERSCOPE® MMS®. Special procedures for particular measuring types are marked accordingly.
- Chapter 2 features an instrument-specific overview of the entire FISCHERSCOPE® MMS® measuring system and Chapter 3 contains start-up and connection instructions.
- Chapter 4 is an introduction to the system, particularly geared to new users. The functions of the MMS® are explained using numerous examples.
- Chapter 5 offers more detailed information and descriptions regarding the available instrument settings and the handling of probes.
- Chapter 6 deals exclusively with operating the instrument and description of the instrument functions.
- Chapter 7 lists the calibration methods for the various measuring methods.
- Chapters 8 to 10 feature background information about influencing factors at certain coating thickness measurement applications as well as for the conductivity and for the ferrite content measurement.
- Chapter 11 deals with the evaluation capabilities featured by the FISCHERSCOPE® MMS®.
- Chapter 12 contains all essential information for data transfer via the RS232 interface.

☞ If no specific measuring types are listed, the description, for instance of a menu function, applies to all measuring types.

Note:
The measurement readings, names of applications, names of features, numbers of measurement data stored in an application, etc., presented here should be understood as examples for possible display readings only. The fact that other values may appear on the display or on a printout does not indicate that a procedure was wrong.

1.2 Warranty

Fischer will not accept warranty claims in any of the following instances:

- Use of instrument and accessories for a different purpose.
- Improper handling of instrument and accessories.
- Ignoring instructions of the operator manual.

Helmut Fischer GmbH + Co is not liable for damage resulting from improper use as well as from repairs or alterations carried out by a third, not authorized party. Great care has been taken in creating this manual. However, a liability due to ordinary negligence, e.g., misprints is excluded.

Helmut Fischer GmbH + Co is not liable for damage or malfunctions caused by options or accessories that are not original Fischer products or are not expressly approved by Helmut Fischer GmbH+Co.

1.3 Environmental conditions for operating and storing the instrument and accessories

- Instrument and accessories are designed for use at temperatures between 10 and 40 °C (50 and 104 °F). The equipment may be stored at temperatures between 5 and 60 °C (41 and 140 °F).

Temperatures behind windows in direct sun light rise easily above 60 °C (140 °F). To avoid damage to the instrument or the accessories by heat, do not keep or store the instruments in such places.

- The instrument complies with the regulations concerning electromagnetic compatibility of instruments (EMVG). The measurements are not influenced by the maximum values of the disturbance variables as mentioned in standard EN 50082-2 (which refers to standards EN 61000-4-2 (IEC1000-4-2), EN61000-4-3 (IEC1000-4-3) and EN61000-4-4 (IEC1000-4-4)).

- **The instrument and accessories must not be operated in an explosive atmosphere.**

- **Instrument and accessories are to be protected against static charge.**
  Electric discharge may delete internally stored data or damage internal components! Electric discharges can occur when connecting a probe.

- **Do not open the instrument and line adapter!**
  Only qualified personnel authorized by Fischer are permitted to open the instrument!

- **The instrument may not come in direct contact with liquids to prevent damage to the instrument!**

1.4 Warnings

- **Working with Beta isotopes is subject to radiation protection regulations. It is imperative to observe the enclosed 'Instructions for handling aperture rings (platens), and calibration standards' !!**

- **Only specially trained personnel are permitted to work with Beta isotopes!**

- **Be careful when handling measurement probe ESL08A** - when handling the probe take care not to injure yourself or other people with the probe tip!

- **The ESL08A probe tip is not acid-resistant** and can be damaged by contact with electrolytes and plating solution.

- **The tip of the probe ESL08A is very sensitive to mechanical stress.** During measurement or calibration the probe tip must be inserted straight into the PTH and withdrawn straight from the PTH.

- **The FISCHERSCOPE® MMS® may be operated only by trained personnel.** In addition, to perform proper coating thickness measurements and evaluations, the operator should have a basic understanding of the measurement technology according to DIN 1319. To integrate a PC, basic computer and programming knowledge or knowledge of the respective software used is required.

2 Instrument Description

2.1 Instrument Versions/Application Selection Chart

Instrument Versions Application	602-269	602-110	602-155	602-156	602-157	602-158	602-216	602-217	602-251	602-252	602-253	602-254	602-255	602-256	Measuring Type (test method)
Coating thickness measurement															
Coating thickness on aliminum food and beverage containers	●														ISOSCOPE® (eddycurrent (DIN EN ISO 2360))
Measurement of non-conductive coatings on NF substrates		●			●	●	●			●			●	●	ISOSCOPE® (eddycurrent (DIN EN ISO 2360))
Measurement of nonconductive and NF coatings on steel or iron	●	●			●	●	●			●			●	●	PERMASCOPE® (magneticinduction (DIN EN ISO 2178))
Measurment of plastic or metal coatings			●			●					●	●		●	BETASCOPE® (betabackscatter (DIN EN ISO 3543))
Measurement of NF coatings (Cu, Zn, Cr, Ni) on iron or steel				●	●				●	●	●	●	●	●	SIGMA (Ni/Fe) SIGMA (NF/Fe) (eddy current)
Measurement of NF coatings (Cu, Zn, Cr, Ni) on non conductive substrates				●					●	●	●	●	●	●	SIGMA (NF/NF) (eddy current)
Measurement of paint/zinc coatings (Duplex) on steel or iron				●					●	●			●	●	SIGMA(DUPLEX) (magnetic induction + eddy current)
Measurement of chrome coatings on non-ferrous metal				●					●	●	●	●	●	●	SIGMA (Cr/NF) (eddy current)

Instrument Versions Application	602-269	602-110	602-155	602-156	602-157	602-158	602-216	602-217	602-251	602-252	602-253	602-254	602-255	602-256	Measuring Type (test method)
Measurement of chrome copper thickness on PC-boards, even under solder resist, and the copper plating thickness in PC-board through holes				●					●	●	●	●	●	●	CU-SCOPE (eddy current)
Measurement of plated nickel coatings on non-conductive or non-ferrous metal substrates does not cover Ni/Fe							●	●				●	●	●	NICKELSCOPE® (magnetic)
Ferrite content measurement															
Ferrite content in austenitic and duplex stainless steel	●	●			●	●	●			●			●	●	FERITSCOPE® (magneticinduction)
Electrical conductivity measurement															
Measurement of the electrical conductivity of non-ferrous metals				●	●				●	●	●	●	●	●	SIGMASCOPE® (eddy current)

NC: Non-conductive substrates

2.2 Contents of Shipment

Please check the shipping carton for possible damage. Should the instrument arrive in a damaged condition, please retain the packing material to assist you in your claims against the carrier.
It is also advisable to keep the carton. It serves as the best container for shipping the instrument.

Please check the completeness of the shipment. If anything is missing, please contact your Fischer representative, or contact Fischer directly.

Standard Contents

The standard contents of the MMS® shipment include:

- MMS® base unit with integrated test method modules as ordered
- A/C line adapter, input : 230 V +10 %, -15 %; 50 Hz or
  input : 115 V +10 %, -15 %; 40 ... 60 Hz
  , Output: 11 Vac/0,9 A
- Operator Manual, English

2.3 Accessories

24-Pin Printer F3100
(May be different, depending on country of delivery)
24-pin dot matrix printer; Paper sizes: continuous paper, width 4,5" to 10", single sheet until size DIN A4 or U.S. letter size (8.27" x 11.69"); Printing speeds: , 240 cps; Emulation: EPSON LQ; Resident fonts: 9 print types incl. proportional type; High graphic resolution: 360 x 330 dpi; Print memory: 44 kB;
Interface: Centronics parallel, RS232C,
Input power: 200 ... 450 V_{AC}, 50 Hz;
Dimensions (W x H x D): 382 x 121 x 282 mm (15" x 4.8" x 11"); Weight: 3,9 kg;
Accessories: power cord, printer cable, 500 sheets of paper, operator manual

F/B container measuring system TM85
To measure the organic coating thickness on the inside and outside of cylindrical aluminum containers (according to DIN 5061) and on aluminum cans. Adaptable to various diameters by single-point calibration without foil.
Range: 0 ... 1000 µm (0 ... 25 mils)
Length of cylinder up to 260 mm (10.2")
Inside diameter of cylinder: 11 ... 82 mm (0.43" ... 3.2")
Aluminum wall thickness of cylinder: ≥ 0,07 mm (2.8 mil)
Accessories: AC line adapter, connecting cable between measuring system and instrument

☞ To operate the F/B measuring system TM85, either the FISCHERSCOPE® MMS® Module TM85 (602-269) or the Module Card TM85 MMS® (602-263) must be integrated in your MMS®!

AC line adapter MMS 110 V (115 V_{AC}/40 ... 60 Hz)

AC line adapter MMS 220 V (230 V_{AC}/50 Hz)

Dust Cover for the FISCHERSCOPE® MMS®
to protect the instrument front panel from dust and humidity

Interface Cable Set MMS®/PC-AT Set
To connect the MMS® to an IBM compatible personal computer. Length of cable: approx. 2 m (7 ft); 9-pin plug and adapter for 25-pin PC serial port.

Interface Cable MMS®/MP1-4
Connecting cable for data transfer between the RS232 interface of all hand-held MP instrument models, except MP 0, and the FISCHERSCOPE® MMS®

Interface Cable MMS®/MP0 (S)
Connecting cable for data transfer between the RS232 interface of the hand-held instrument, model MP0 (S), and the FISCHERSCOPE® MMS®

FCC Software
PC Software to manage, document and archive all application related measurement and customer data. Also provides full SPC/SQC support capability.
Using a bi-directional interface, calibration data are managed as well and transferred to the instrument when an application is called.

PC-Datex
PC software to export data into an MS Excel spreadsheet. System requirements: MSWindows® 95, MSExcel® 95 (7.0) or later software version.

Report Software MMS®
PC Software to create printer report templates in 5 languages for the FISCHERSCOPE® MMS® for user-defined documentation of results.
The templates are transferred from the PC to the MMS® via the RS232 interface.

☞ Interface MMS®/PC-AT Set is required!

Support Stand V12
Stand for reproducible positioning of axial probes on specimens. Accessories included: 3 adapters for the various axial probe models.

Right Angle Probes Adapter
Adapter for using right angle probes (e.g., probe EGABW1.3) with the support stand V12.

Adapter for Interior Probes
Adapter for using inside probes (e.g., probe EGABI1.3 - 150 mm) with the support stand V12.

Measuring Table Z14NG
To measure small parts using the beta backscatter method (Geiger Müller counter tube).
Can be connected to the FISCHERSCOPE® MMS® Module BETA. Universal weight pin, including GM tube and tools for changing the platen rings and beta sources of the model series C 07.03.xxx

Universal Measuring Table Z6NGB2
To measure pc boards, sheet and strip specimens using the beta backscatter method (Geiger Müller counter tube).

Can be connected to the FISCHERSCOPE® MMS® Module BETA. Adjustable height, illuminated measurement area with dual line crosshairs, support for aperture rings with diameters up to 32 mm (1.26"), GM tube, start button

Relay Contact Signal Adapter MMS®
Adapter to connect to the multi function connector of the MMS® for relays contact closure outputs

Food Pedal Switch for Measurements with External Start

Calibration Standard Sets %Fe-WRC FN
Calibration standard sets each with one base and several standards. Dual markings in %Fe and WRC FN.

2.4 Options

Plug-in testing modules and connector modules to expand the FISCHERSCOPE® MMS®. Depending on the version of the instrument, the unit can be expanded for new measurement applications:

Plug-in testing modules/connector modules needed for the expansion		**Available Instrument Versions**													
Connector modules for the plug-in testing module(s)	Plug-in testing module	MMS® PERMASCOPE® / 602-110	MMS® BETASCOPE® / 602-155	MMS® SIGMASCOPE ®/ 602-156	MMS® PS / 602-157	MMS® BP / 602-158	MMS® NP / 602-216	MMS® NICKELSCOPE ®/ 602-217	MMS® DUPLEX / 602-251	MMS® DP / 602-252	MMS® BS / 602-253	MMS® BNS / 602-254	MMS® DNP / 602-255	MMS® BDNP / 602-256	MMS® TM85 / 602-269
Connector module MMS® 8/8 602-272	TM85 MMS® 602-263	-	●[1]	●[1]	-	-	-	●[1]	●[1]	-	●	●	-	-	○
	PERMASCOPE® MMS® 602-264	○	●[2]	●[2]	○	○	○	●[2]	●[2]	○	●[2]	●[2]	○	○	-
Connector module MMS® 5/2 602-271	BETASCOPE® MMS® 602-267	●	○	●	●	○	●	●	●	●	○	○	●	○	●
Connector module MMS® 14/19 602-273	NICKELSCOPE® MMS® 602-265	●	●	●	●	●	○	○	●	●	●	○	○	○	●
	SIGMASCOPE® MMS® 602-266	●	●	○	○	●	●	●	●	●	○	○	●	●	●
	DUPLEX MMS® 602-268	●	●	○	●	●	●	●	○	○	●	●	○	○	●

○	Plug-in testing module(s)/connector module(s) installed in this instrument version
●	Instrument version expandable with appropriate module/module board
-	not expandable
1	cannot be used with eddy current probes (e.g., ETA3.3); all magnetic induction probes (e. g., EGAB1.3) can be used. Plug-in testing module TM85 MMS® cannot be expanded together with the plug-in testing module PERMASCOPE® MMS®.
2	Cannot be expanded together with the plug-in testing module TM85 MMS®.

☞ **Expansions must be performed by Fischer or an authorized service representative!**

2.5 Probes

Automatic Probe Recognition

All probes that can be connected to the FISCHERSCOPE® MMS®, except for beta probes, include a memory chip in their probe connector (probe names beginning with E....). These memory chips store probe-specific information (e.g., probe model, test method, calibration coefficients, etc.). The instrument imports these data after every power-up and 'recognizes' the probe based on these data.

Probe Selection

Different probe models are available to measure objects of different shapes as well as for the various measurement applications (coating thickness, ferrite content, e. conductivity). Information regarding available probe models or the model best suited for a particular application can be obtained from your Fischer representative or directly from Fischer.
The standard content of a probe shipment includes:

- Coating thickness probe (except beta probes)

- probe-specific set of standard foils/standards for the master calibration (if an on-site master calibration can be performed)
- probe-specific set of standard foils/standards for the corrective calibration or normalization
- Saturation standard (depending on the application)
- uncoated base material for functional test only

- Beta probe

- Isotope
- JEWELRING® platen
- A calibration standard set for the calibration can be ordered from Fischer or your Fischer representative

- Ferrite probe

- Probe alone. A calibration standard set for the corrective calibration can be ordered from Fischer or your Fischer representative

- El. conductivity probe

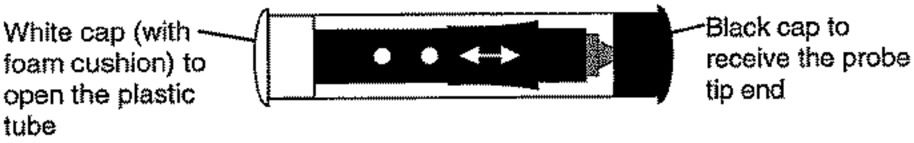
- El. conductivity standard, Cu 58 MS/m - 100% IACS

2.5.1 Probe ESL08A

Shipping

The ESL08A probe tip is extremely sensitive to mechanical stress.

☝ **Please make sure that the probe cartridge is always shipped in the protective plastic tube!**



Protection from Corrosive Liquids

The probe tip is not acid-resistant and can be damaged by contact with electrolytes and plating solution.

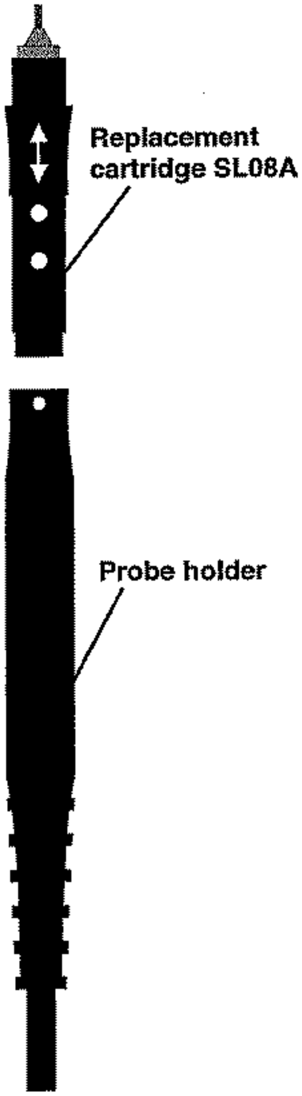
Please remove all electrolyte residue from the hole to be measured in prior to making the measurement!

Warranty

Fischer does not accept warranty claims if the probe is handled improperly, e.g., shipping the probe cartridge outside of the plastic tube, damage due to contact with electrolytes, bent tips due to forcing the probe in or out of holes, etc.

2.5.2 Replacing the Cartridge SL08A

If the probe tip is damaged, only the front portion of the probe (replacement cartridge SL08A) needs to be replaced.
The replacement cartridge is plugged into the back portion of the probe, the probe holder.



- Pull the replacement cartridge in the direction of the probe tip to remove the cartridge from the probe holder.

Be careful when handling measurement probe ESL08A - when handling the probe take care not to injure yourself or other people with the probe tip!

Do not twist the replacement cartridge while removing it from the probe holder! Twisting the cartridge in the holder will damage the connector.

Be careful not to damage the probe tip when replacing the cartridge.

- Align the white dots on the replacement cartridge with the white dot on the probe holder when plugging the replacement cartridge into the probe holder.

The master calibration data stored in the probe connector is replacement cartridge specific. Thus, a master calibration needs to be performed when replacing the cartridge SL08A or the probe holder (incl. connection cable and probe plug) in a probe ESL08A.

See Chapter 7, Section 'Master Calibration', beginning at page 7-32.

2.6 Technical Data

Technical Data

Power Supply:	230 Vac + 10 %, - 15 %, 50 Hz 115 Vac + 10 %, - 15 %, 60 Hz connection via external A/C adapter, length of cord approx. 1.70 m (6 ft) (included)
Power consumption:	max. 9,9 VA
Fuse for power supply:	Replacement by Fischer only
Battery:	memory backup, life expectancy approx. 8 years, replacement by Fischer only
Dimensions (mm):	350 x 140 x 200 (H x W x D)
(inches):	13.8 x 5.5 x 7.9 (H x W x D)
Weight:	3 kg (6.6 lbs) (maximum configuration)
Operating temperature:	+ 10 ... + 40 °C (+ 50 to + 140 °F)
Operating humidity:	30 ... 90 % RH, non condensing
Display:	LCD graphics display, 126 x 70 mm (5" x 3"), backlit
Measuring range:	dependent on the probe connected
Measurement methods	
Coating thickness:	magnetic induction, eddy current, beta backscatter, magnetic
Ferrite content:	magnetic induction
El. conductivity:	eddy current
Types of presentation:	Numeric display, specification limit display, SPC chart, simple operating mode
Evaluation:	Statistics: mean value, standard deviation, coefficient of variation, range, minimum, maximum, histogram, probability chart, SPC control chart (Statistical Process Control): lower/upper control limits, specification limits, C_p, C_{pk}, s_I, s_a
RS232:	9-pin MinD connector, data format is menu selectable
Printer port:	25-pin MinD connector, Centronics parallel
Multifunction connector:	15-pin MinD connector, signal output: TTL level (5 V/5 mA)

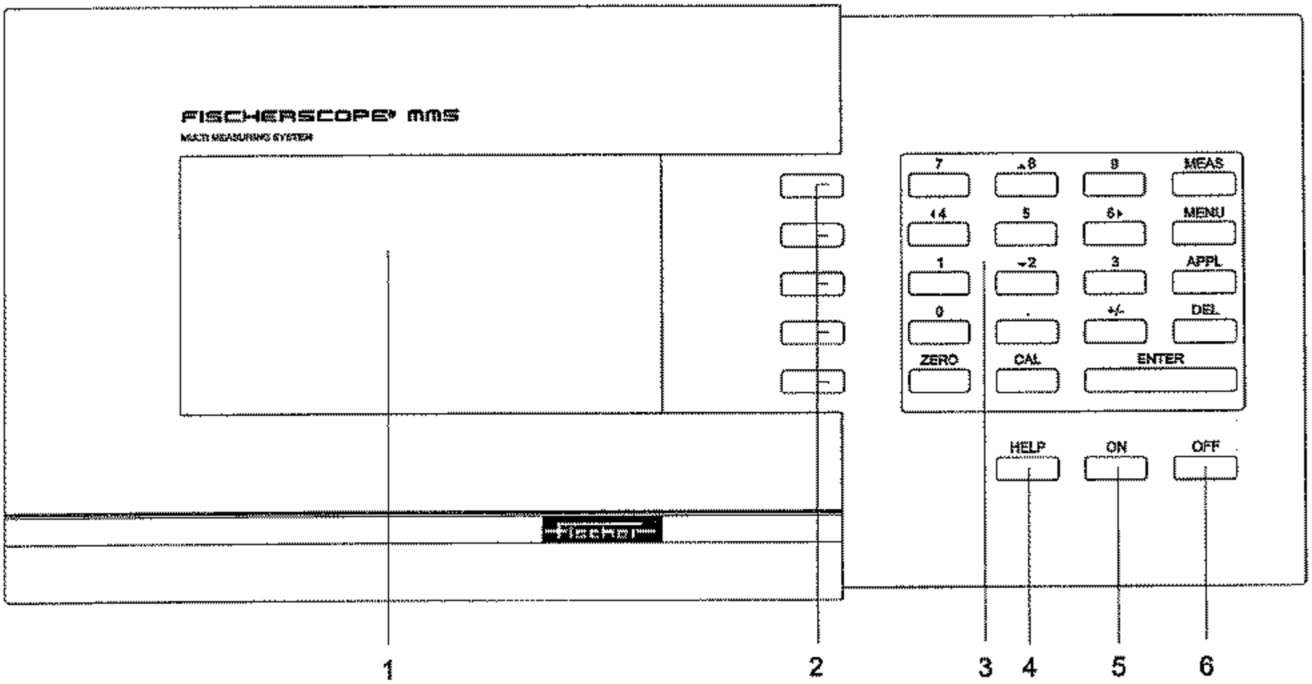
Coating thickness measurement (except BETA):
The calibration standards and foils used must be within the appropriate normalized countrate (probe signal) interval. The normalize countrate represents the probe signal change from bare substrate material ($Xn = 0$) to coating material saturation thickness ($Xn = 1$).

Calibration standards: $0.02 \leq Xn_{Standard} \leq 0.95$

Calibration foils: $0.1 \leq Xn_{Foil} \leq 0.7$.

When using two calibration foils, the difference between the two foil thicknesses must be $\Delta Xn_{Foil} < 0.1$.

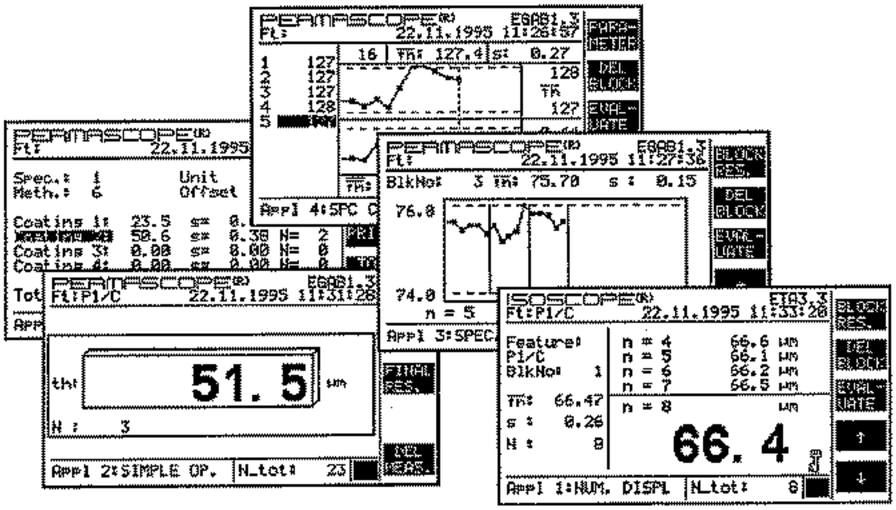
2.7 Instrument Components



FISCHERSCOPE® MMS® Front Panel

1 Display (see Section 'Display Description')
2 Softkeys, the functions activated by these keys are indicated on the right side of the display (📖 see also up from page 6-35)
3 Keypad (see Section 'Keypad Description')
4 HELP key, to call a help function
5 ON key, to switch the instrument ON
6 OFF key, to switch the instrument OFF

2.7.1 Display Description



A description of the displays for the types of measurement (numeric display, specification limit display, and SPC control chart) can be found in Chapter 5, page 5-11, and for the difference measurement, page 5-21.

A description of the simple operating mode can be found in Chapter 5, page 5-19.

2.7.2 Keypad Description

0 , ..., 9 ,
. , +/-

Number-, . - and +/- keys for alphanumeric Entries.

+/- key to Print the menu screens in the normalization function.

+/- key to Switch between capital and small letters in the character fields.

▼2 , ◀4 , 6▶ ,
▲8

Number keys with ▲ to move the cursors (highlights) in the entry and selection windows of the display.

Hot Key Functions:

ZERO

ZERO **key** to Call the normalization function.
to Print the display screens, menu pages of the menu functions and the measuring mode.

CAL

CAL **key** to call the calibration function.

ENTER

ENTER **key** to Confirm the Entry/Selection.
to Move the Cursor (highlight) from one entry/selection window to the next in a menu screen.

DEL

DEL **key** to delete the last measurement in the current measurement display screen or the last entry with the keypad.
Also used to delete parameters in menu function 1.

APPL

APPL **key** to call the application selection menu.

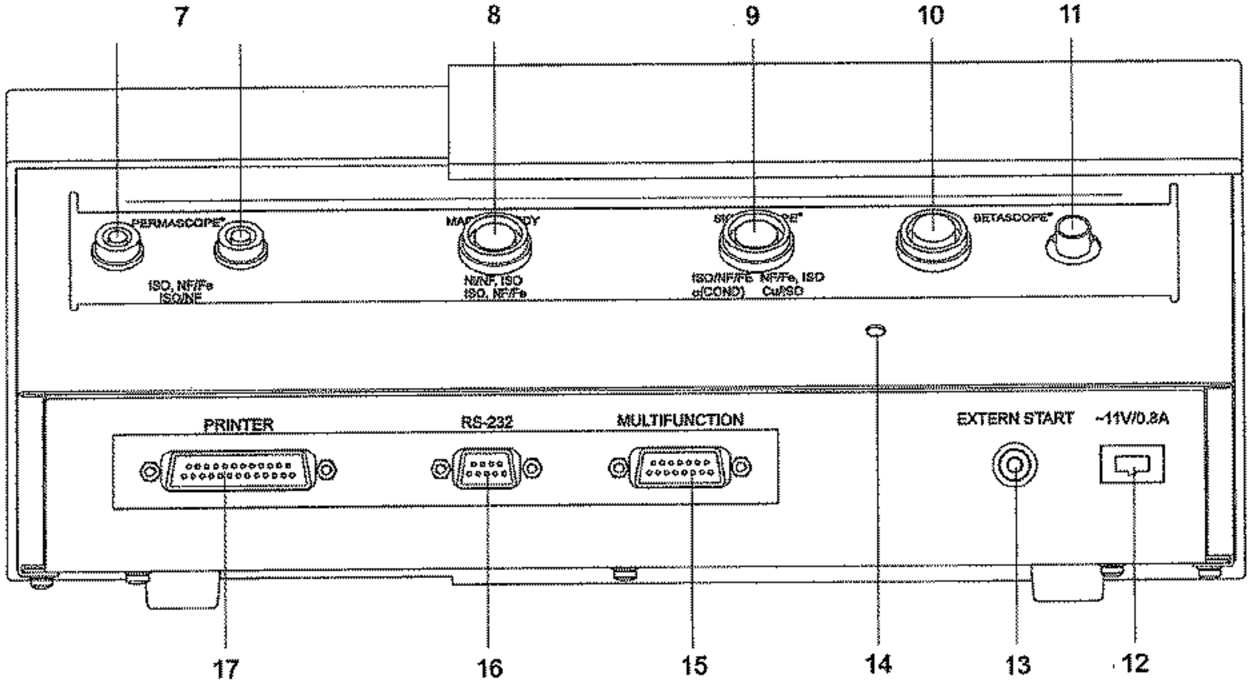
MENU

MENU **key** to call the selection menu of the menu functions (📖 for greater details on the menu functions see Chapter 6, page 6-43).

MEAS

MEAS **key** to call the measuring mode of the current application.

FISCHERSCOPE® MMS Back Panel



7 Two 8-pin sockets for connecting probes for coating thickness measurement according to the magnetic induction and eddy current methods, and for connecting probes for ferrite content measurements.

8 19-pin socket to connect probes for measuring Nickel and thick non-ferrous coatings.

9 14-pin socket to connect probes to measure the electrical conductivity, to measure coatings (copper) on the inside of holes, and to measure double coatings (duplex coatings).

10 5-pin socket to connect measuring tables and probes for coating thickness measurements according to the beta backscatter method.

11 BNC-socket to connect measuring tables and probes for coating thickness measurements according to the beta backscatter method.

12 Connector for the A/C adapter.

13 Socket for external start switch.

14 Speaker opening.

15 15-pin MinD socket, multi function connector with signal outputs for upper and lower limit violations, external start, and to connect a temperature sensor for the el. conductivity measurement.

16 9-pin MinD socket, RS232C interface to connect to an external computer.

17 25-pin MinD socket, printer connector, Centronics parallel (pc compatible printer output).

3 Start-Up

3.1 Connections

Capability to connect

- Probes to measure the coating thickness (magnetic induction, eddy current, beta backscatter, magnetic), the ferrite content, and the electrical conductivity
- External devices: printer, PC
- Temperature sensor (Pt100) used only for el. conductivity measurement)
- Signals: upper/lower limit violations, measurement ok.
- Switch for external start of the measurement

Connections Probes	PERMASCOPE® 2 x 8-pin 	BETASCOPE® 5-pin BNC 	SIGMASCOPE® 14-pin 	MAGNA/EDDY 19-pin 
Coating thickness				
EG..., EK...	●			
ET..., EA...,	●			
ED...	●			
ESD.... ESG..., ESC1, ESL...			●	
EN3				●
Beta probes		●		
Ferrite content				
EGAB1.3-Fe, EGABW1.3-Fe	● ●			
El. conductivity				
ES...			●	

●: possible probe connection to corresponded socket

Probe connections

☞ **Change probes only when the instrument is turned off!**

☞ The two PERMASCOPE® sockets are alike.

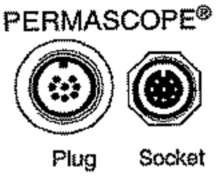
☞ Do not connect probes using the same test method to both PERMASCOPE® sockets! ☞ Connecting two probes with the same test method see page 3-5.

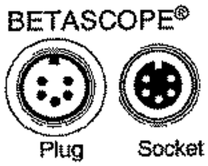
☞ **Allowed**: magnetic induction probe e.g., EGAB1.3 and eddy current probe, e.g., ETA3.3.
Not allowed: two eddy current probes, e.g., ETA3.3, or one magnetic induction probe to measure the coating thickness, e.g., EGAB1.3, and one probe to measure the ferrite content, e.g., EGAB1.3-Fe or one dual probe, e. g., ED10, or a dual probe ED10 and a eddy current probe, e. g., ETA3.3.

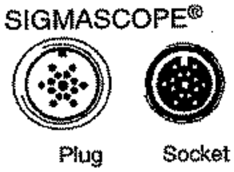
Connecting a Probe

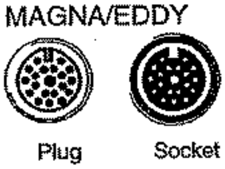
OFF

- Switch instrument OFF (if not off already)
- Plug probe connector into the correct probe socket:









PERMASCOPE®, 8-pin sockets

BETASCOPE®, 5-pin socket and BNC socket:
BNC socket: for Geiger-Müller counter tube connector.
5-pin socket: lighting and start button connector for the measuring table Z6NGB2.

SIGMASCOPE, 14-pin socket
The temperature sensor for the el. conductivity measurement is connected to the multifunction connector. See page 3-4 for the pin-out.

MAGNA/EDDY, 19-pin socket

☝ **When plugging in the probe, ensure that the keyway of the plug is aligned with the notch of the socket. Do not attempt to plug in the connector in any other way. Doing so will result in a faulty connection between the instrument and the probe, and might damage the pins of the probe plug.**

- Tighten the knurled nut of the probe plug at the instrument socket.

ON

- Switch the instrument ON.

☞ The instrument recognizes and displays the **connected probe model**. If the application displayed has not been normalized (calibrated) with this type of probe, the message "Wrong" will appear on the display. When connecting another probe type (other test method), the message "Missing" will be displayed. If two of the same probe types (same test method) are connected to the PERMASCOPE® sockets, the message "equal" will appear.

Printer Connector

Connector: 25-pin MinD socket
Pin-Out:

Pin 1 Strobe -	Pin 10 ACK	Pin 18 GND
Pin 2 Data Bit 0	Pin 11 Busy	Pin 19 GND
Pin 3 Data Bit 1	Pin 12 PE	Pin 20 GND
Pin 4 Data Bit 2	Pin 13 Select (SLCT)	Pin 21 GND
Pin 5 Data Bit 3	Pin 14 Auto Feed XT -	Pin 22 GND
Pin 6 Data Bit 4	Pin 15 ERROR -	Pin 23 GND
Pin 7 Data Bit 5	Pin 16 Init -	Pin 24 GND
Pin 8 Data Bit 6	Pin 17 Select IN (SLCTIN) -	Pin 25 GND
Pin 9 Data Bit 7		

☞ The printer port is a Centronics (parallel) interface. The **data format is set** through menu function 30 of the Supervisor menu (📖 see Chapter 6, Section '30 Printer Selections', page 6-89).

PRINTER

RS232 Connector

Connector: 9-pin MinD socket
Pin-Out:

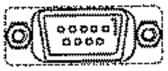
Pin 1 open	Pin 6 DTR (Data Terminal Ready, →)
Pin 2 T x D (Transmit Data, →)	
Pin 3 R x D (Receive Data, ←)	Pin 7 CTS (Clear To Send, ←)
Pin 4 DSR (Data Set Ready, ←)	Pin 8 RTS (Request To Send, →)
Pin 5 GND	Pin 9 open

☞ For safe operation, a shielded connector cable with a total length according to DIN 47100 should be used.

☞ The **data format is set** from menu function 31 of the Supervisor menu (📖 see Chapter 6, Section '31 Serial Port Configuration', page 6-90).

📖 See also Chapter 12 "RS232 Data Transfer".

RS-232



MULTIFUNCTION

Multifunction Connector

Connector: 15-pin MinD socket
Pin-Out:

Pin 1	1 (temp. sensor TF 100)	Pin 8	Signal output indicating that the measurement is below the lower limit
Pin 2	3 (temp. sensor TF 100)		
Pin 3	open	Pin 9	2 (temp. sensor TF 100)
Pin 4	External start	Pin 10	4 (temp. sensor TF 100)
Pin 5	Measurement impulse	Pin 11	GND
Pin 6	Signal output indicating that the measurement is within the set limits	Pin 12	Control line[1]
		Pin 13	GND
Pin 7	Signal output indicating that the measurement is above the upper limit	Pin 14	open

1: For switching on see Chapter 6, page 6-102.

☞ Pins 1, 2, 9 and 10 are provided for a Pt100 temperature sensor, which can be used for **temperature compensation during the electrical conductivity measurement**.

☞ The **external trigger switch** must have normally open contacts.

☞ All **signal outputs** and the control lines supply a signal at TTL level (5 V/5 mA)

EXTERNAL START

External Start

Connector: Socket, which has the same function as pin 4 of the multifunction connector.

☞ The **external measurement trigger switch** must have normally open contacts. Also the ENTER key of the MMS® can be used.

☞ **Foot pedal for external measurement start** can be ordered.

☞ The external start function **must be activated** in **menu function 18** of the MMS® (📖 see Chapter 6, page 6-70).

Plug of the AC line adapter

Power socket of the MMS®

Power Connector

Socket for the connector of the A/C adapter (included with the instrument).

☝ When plugging in the AC line adapter, ensure that the keyway of the plug fits into the notch of the socket. Do not attempt to plug in the connector in any other way. Doing so will result in faulty connections!

3.2 Battery

The FISCHERSCOPE® MMS® includes a battery for memory backup (when the instrument is switched off). Life expectancy approx. 8 years.

Replacement of the battery must be carried out by Fischer.

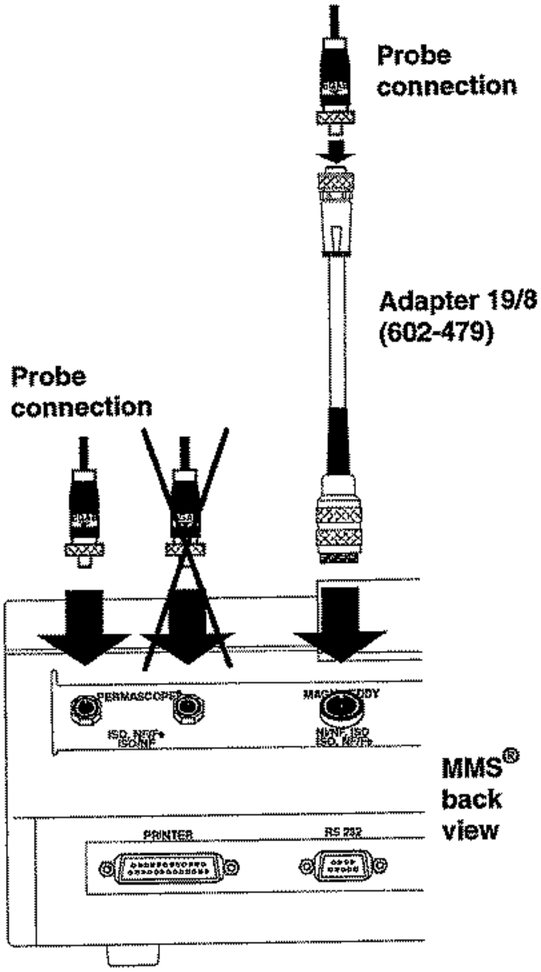
A defective or empty battery will result in data loss!

3.3 Connecting two probes using the same measurement method

Adapter 19/8 (602-479)

You can use the adapter 19/8 to connect a magnetic induction probe or an eddy current probe to the MAGNA/EDDY socket. The adapter must be enabled in menu function 40. In this case, the second magnetic induction probe or eddy current probe, respectively, should be connected to the outer of the two PERMASCOPE® sockets (see figure to the right).

Enabling menu function 40, Chapter 6, Page 6-104.



4 Introduction

Sections 4.1 to 4.3 feature a brief introduction to the operation of the instrument. Section 4.4 offers various examples.

4.1 Switching the MMS® ON/OFF

ON

- Use the ON key to switch the **instrument ON**. The instrument goes immediately to the measuring mode of the application last used.

☞ Peripheral devices, such as printers or computers, can be connected while the instrument is switched ON.

OFF

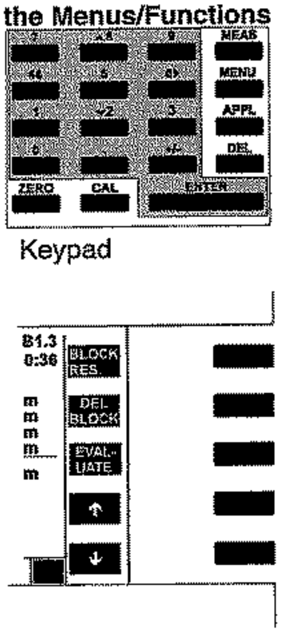
- Use the OFF key to switch the **instrument OFF**.

☞ **Connect or change probes only when the instrument is switched OFF!**
🗐 See Chapter 3 Start-Up.

4.2 Operating Principle, General

After switching the instrument ON, the instrument goes immediately to the measuring mode of the application last used. Measurements using the proper probe for the application can be started immediately.

Selection/Entries in the Menus/Functions



Softkeys

Selections and entries in the various menu functions, menus and in the measuring mode are made using the keys of the numeric keypad and the softkeys.

Softkeys are context-sensitive keys, that is, their function changes depending on the menu page selected. The current function is shown in the right margin of the display, and is assigned to the key that is horizontally next to it. 🗐 Chapter 6.2, Section "Description of the Softkeys", offers a description of the recurring softkey functions.

Operation of the instrument follows the same pattern for all applications and measurement types. Applications and menu functions are always called in the same manner. The same is true for the normalization and calibration functions.

4.3 Quick Path to Measurements

New Measurement Application

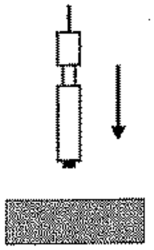
New Measurement Application (general procedure):

- Connect the Instrument to AC power
  (253 ... 190,5 or 110-120 VAC, 50-60 Hz, depending on country;
  📄 see also Chapter 3 Start-Up, Power connection).
- Connect the probe to the instrument (📄 see Chapter 3, Connecting a Probe).
- Switch the instrument ON (ON ▬).
- Define an application (at the instrument define/save; copy).
  📄 see also Chapter 6, sections "Short-Form Instruction: Instrument Operation" and "Description of the Softkeys".
- Calibration/Normalization,
  📄 see also Chapter 7.
- Measurement.

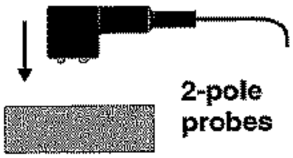
Measurements in existing applications

Measurements in existing applications (general procedure):

- Connect the instrument to AC power,
  (253 ... 190,5 or 110-120 VAC, 50-60 Hz, depending on country;
  📄 see also Chapter 3, Power connection),
  proper probe for the measurement application is already connected to the instrument; if not, connect the probe.
- Switch the instrument ON (ON ▬).
- Select the desired application (if necessary).
- Measurement
  (<u>Exception</u>: with the BETA, always normalize before the actual measurement, 1x per day).



1-pole probes



2-pole probes

☞ Handling of the hand-held probes

- Always place the probe gently on the specimen and perpendicular to the specimen. Avoid impacting the probe. Do not scratch the surface.
- Do not let the probe float above the surface. Doing so leads to erroneous measurements.
- As soon as the probe is lifted off the specimen (min. 50 mm (0.2")), the instrument is ready for the next measurement.

☞ When using a **beta probe**, it is **imperative to observe** the instructions for handling aperture rings, emitters and calibration standards **prior to operation.**

4.4 Examples

Starting on page 4-7, various examples are presented to demonstrate operation with the MMS®.

Overview

Coating Thickness Measurement:

Example 1 PERMASCOPE®
Application: Zn/Fe
Define a new application
Numeric display
Normalize the measuring system for the application
Document the single readings

Page 4-7

Example 2 PERMASCOPE®
Define and assign features
Numeric display

Page 4-10

Example 3 PERMASCOPE®
Application: Cr/Fe
Define a new application
Numeric display
Reject outlier measurements
Specification limit monitoring
Evaluation with automatic printout
Automatic block result
Normalize the measuring system for the application
Document block results without single readings

Page 4-17

Example 4 PERMASCOPE®
Application: Cr/Fe
Copy an application
Change parameter settings
Document block results including single readings

Page 4-22

Example 5 PERMASCOPE®
Application: Zn/Fe
Define a new application
Specification limit display
Reject outlier measurements
Specification limit monitoring
Normalize the measuring system for the application
Document the single readings

Page 4-26

Page 4-30

Example 6 PERMASCOPE®
Application: Zn/Fe
Define a new application
SPC Control chart display
Calculate the upper and lower control limits using the MMS
Normalize the measuring system for the application

Page 4-35

Example 7 PERMASCOPE®
Application: 4 paint coating layers on metal sheet
Define a new application
Difference measurement
Normalize the measuring system for the application

Page 4-38

Example 8 SIGMA (DUPLEX)
Application: Paint/Zn/Fe (Two coatings on steel)
Define a new application
Specification limit display
Normalize the measuring system for the application

Page 4-43

Example 9 SIGMA (NF/FE)
Application: Zn/Fe
Define a new application
Numeric display
5 Measurements are to be combined into a so-called mean measurement.

Page 4-47

Example 10 NICKELSCOPE®
Application: Ni/Cu
Define a new application
Specification limit display
Specification limit monitoring
Evaluation with automatic printout
Automatic block result
Normalize the measuring system for the application

☞ The examples also apply to coating thickness measurements on non-ferrous substrates (e.g., aluminum). The upper left-hand corner of the display will then show ISOSCOPE®, for instance instead of PERMASCOPE®

Coating Thickness Measurement with a Beta Probes:

Page 4-53

Example 1 BETA
Application: Measurement of the coating thickness of gold-plated contact pins (Au/Brass)
Define a new application
Numeric display
Specification limit monitoring
Evaluation with automatic printout
Automatic block result

Calibrate the measuring system for the application
Normalize the measuring system for the actual substrate
Document block results without single readings

Page 4-62

Example 2 BETA
Application: Paint/Cu
Define a new application
Specification limit display
Specification limit monitoring
Automatic block result
Calibrate the measuring system for the application
Document the single readings and the block results

☞ Procedures presented in the PERMASCOPE® examples (such as defining/assigning features, copying applications, and defining parameters) apply also to measurements with a beta probe.

Ferrite Content Measurement:

Page 4-69

Example 1 FERITSCOPE®
Numeric display
Specification limit monitoring
Normalize the measuring system for the application

☞ Procedures presented in the PERMASCOPE® examples (such as defining/assigning features, copying applications, and defining parameters) apply also to ferrite content measurements.

Electrical Conductivity Measurement:

Page 4-73

Example 1 SIGMASCOPE®
Numeric display
No temperature compensation
Normalize the measuring system for the application

Page 4-76

Example 2 SIGMASCOPE®
Numeric display
Temperature compensation
Normalize the measuring system for the application

☞ Procedures presented in the PERMASCOPE® examples (such as defining/assigning features, copying applications, and defining parameters) apply also to electrical conductivity measurements.

Page 4-81

Simple Operating Mode - Example

Switching from the standard operating mode to the simple operating mode and switching back to the standard operating mode.

Example 1 PERMASCOPE®

Measurement of a Zinc coating on steel.

Application:
- Numeric Display
- Documenting single readings
- Normalize measuring system for application

A **new Application will be created** for the measurement application mentioned above. No further parameters need to be entered because Numeric Display and Documenting Single Readings conform to the standard set-up of the MMS®. **Normalization** is performed directly **on the substrate material** (uncoated piece of steel).

For a description of the measurement presentation mode "Numeric Display", see Chapter 5, Section "Numeric Display".

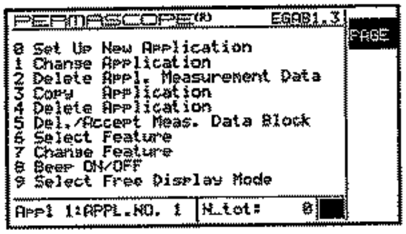
For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys see Chapter 6.

Preparation:
- A model EGAB1.3 magnetic induction probe is suitable for this measurement application.
- Connect the probe to the MMS®.
- Switch the MMS® on, ON key.

Key Sequence **Display** **Comments**

Setting-Up an Application

MENU

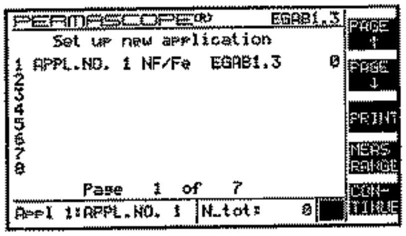


```
PERMASCOPE®            EGAB1.3   PAGE
0 Set Up New Application
1 Change Application
2 Delete Appl. Measurement Data
3 Copy   Application
4 Delete Application
5 Del./Accept Meas. Data Block
6 Select Feature
7 Change Feature
8 Beep ON/OFF
9 Select Free Display Mode
Appl 1:APPL.NO. 1  |N_tot:      0
```

Calls the menu function screen.

A list of all menu functions is displayed covering several pages.

0 ENTER

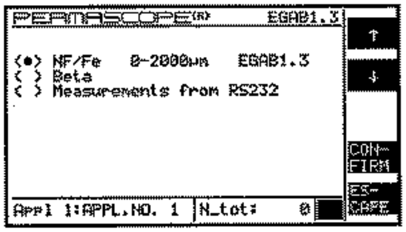
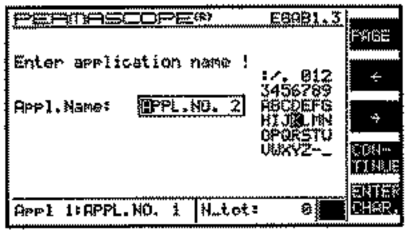
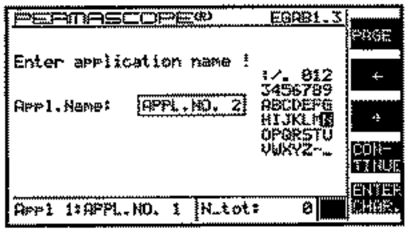
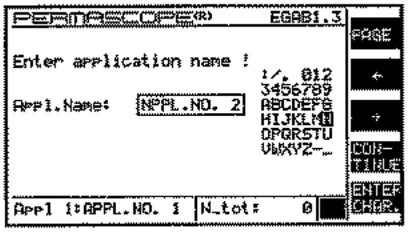
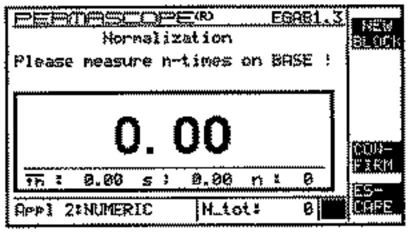


```
PERMASCOPE®            EGAB1.3   PAGE ↑
   Set up new application
1 APPL.NO. 1 NF/Fe  EGAB1.3     0  PAGE ↓
2
3                                  PRINT
4
5                                  MEAS RANGE
6
7
8                                  CON-TINUE
      Page   1  of   7
Appl 1:APPL.NO. 1  |N_tot:      0
```

Enter the Number 0 to open the menu function "Set Up New Application".

A screen with page 1 of all previously created applications appears.

Setting-Up an Application / Probe Selection / Entering Names

Key Sequence	Display	Comments
▼2 ENTER		Enter the number for the new application. The instrument searches for connected probe models and displays them in a list. ☞ If the MMS® contains a BETASCOPE® MMS® plug-in testing module (602-267) Beta (for beta emitter) will always be displayed in the list.
CON-FIRM		Select the probe model (NF/Fe ...). A menu page to enter the name of the application will be displayed.
▼2, ◀4, 6▶, ▲8, ENTER CHAR.		In our example: NUMERIC. Use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR.
		☞ Use the DEL key to delete erroneous entries or unnecessary characters. On how to enter names see also Chapter 6, page 6-24.
PAGE		The softkey PAGE can be used to open 4 additional menu pages to enter/select parameters/functions.
CON-TINUE		No additional parameter entries, change to the normalization routine.

Display 1:

```
PERMASCOPE(R)                EGAB1.3

(•) NF/Fe    0-2000µm    EGAB1.3
( ) Beta
( ) Measurements from RS232

Appl 1:APPL.NO. 1  N_tot:       0
```

Display 2:

```
PERMASCOPE(R)                EGAB1.3

Enter application name !
                               :/. 012
                               3456789
Appl.Name:    APPL.NO. 2       ABCDEFG
                               HIJKLMN
                               OPQRSTU
                               VWXYZ-_

Appl 1:APPL.NO. 1  N_tot:       0
```

Display 3:

```
PERMASCOPE(R)                EGAB1.3

Enter application name !
                               :/. 012
                               3456789
Appl.Name:    APPL.NO. 2       ABCDEFG
                               HIJKLMN
                               OPQRSTU
                               VWXYZ-_

Appl 1:APPL.NO. 1  N_tot:       0
```

Display 4:

```
PERMASCOPE(R)                EGAB1.3

Enter application name !
                               :/. 012
                               3456789
Appl.Name:    NPPL.NO. 2       ABCDEFG
                               HIJKLMN
                               OPQRSTU
                               VWXYZ-_

Appl 1:APPL.NO. 1  N_tot:       0
```

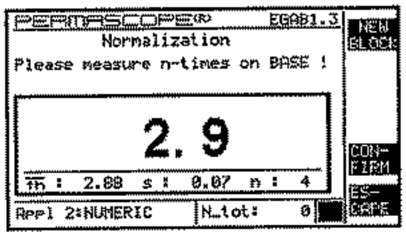
Display 5:

```
PERMASCOPE(R)                EGAB1.3
           Normalization
Please measure n-times on BASE !

               0. 00
 x̄ :   0.00   s :   0.00   n :   0

Appl 2:NUMERIC     N_tot:       0
```

Normalization

Key Sequence **Display** **Comments**

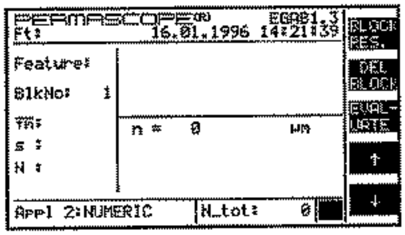
Measure n times on the uncoated specimen (steel).



```
PERMASCOPE®            EGAB1.3
        Normalization
Please measure n-times on BASE !

             2.9
 th :  2.88   s :  0.07   n :  4
Appl 2:NUMERIC     N_tot:     0
```

Repeat the measurement until the reading changes only slightly or not at all.

CON-FIRM



```
PERMASCOPE®              EGAB1.3
Ft:          16.01.1996 14:21:39
Feature:
BlkNo:    1
th:
s :            n =   0       µm
N :
Appl 2:NUMERIC     N_tot:     0
```

Save the application, change to the measurement mode of the newly created Application Number 2, NUMERIC.

☞ We recommend to make reference measurements prior to the actual measurements to prevent measurement errors.
For greater details see Chapter 6, page 6-34.

Example 2 PERMASCOPE®

Assigning Features

During a measurement, features are assigned to a measurement series (block). In this example, first 3 **Features will be defined**, and in a second part they **will be assigned to individual blocks**.

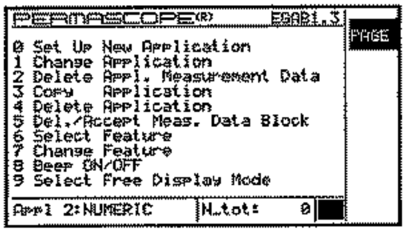
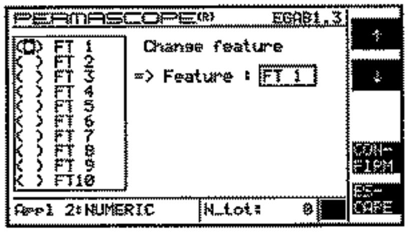
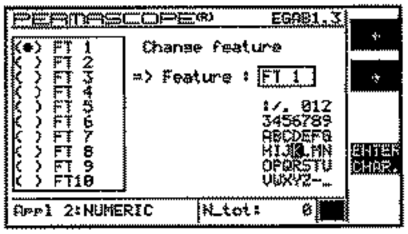
For a description of the measurement presentation mode "Numeric Display", see Chapter 5, Section "Numeric Display".

For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys see Chapter 6.

Preparation:
- Application Number 2, NUMERIC, is used as a basis for this example (see Example 1 PERMASCOPE®).
- Probe model EGAB1.3.
- Switch the MMS® on, **ON** key.
- Call Application Number 2: **▼2**, **APPL** (if not already active on the display).

Defining a feature:

Define the Feature 1 (FT 1)

Key Sequence	Display	Comments
MENU		Calls the menu function screen. A list of all menu functions is displayed covering several pages.
7 **ENTER**		Enter the number 7 to open the menu function "Change Feature". The respective menu will open.
ENTER		Confirm the selected feature (FT 1) and highlighted alphanumeric character of the character selection field.

```
PERMASCOPE(R)             EGAB1.3   PAGE
0 Set Up New Application
1 Change Application
2 Delete Appl. Measurement Data
3 Copy   Application
4 Delete Application
5 Del./Accept Meas. Data Block
6 Select Feature
7 Change Feature
8 Beep ON/OFF
9 Select Free Display Mode
Appl 2:NUMERIC        N_tot:      0
```

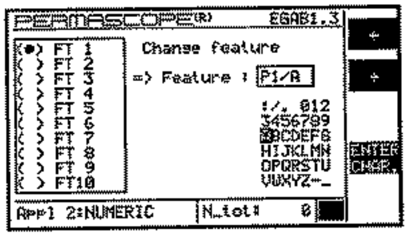
```
PERMASCOPE(R)             EGAB1.3
(●) FT 1   Change feature
( ) FT 2
( ) FT 3   => Feature : FT 1
( ) FT 4
( ) FT 5
( ) FT 6
( ) FT 7
( ) FT 8                            CON-
( ) FT 9                            FIRM
( ) FT10                            ES-
Appl 2:NUMERIC        N_tot:      0 CAPE
```

```
PERMASCOPE(R)             EGAB1.3
(●) FT 1   Change feature
( ) FT 2
( ) FT 3   => Feature : FT 1
( ) FT 4
( ) FT 5                 :/. 012
( ) FT 6                 3456789
( ) FT 7                 ABCDEFG
( ) FT 8                 HIJKLMN    ENTER
( ) FT 9                 OPQRSTU    CHAR.
( ) FT10                 VWXYZ-_
Appl 2:NUMERIC        N_tot:      0
```

Key Sequence | **Display** | **Comments**

Define the Feature 1 (FT 1)

▼2, ◀4, 6▶, ▲8, ENTER CHAR.



PERMASCOPE® EGAB1.3

(●) FT 1
( ) FT 2
( ) FT 3
( ) FT 4
( ) FT 5
( ) FT 6
( ) FT 7
( ) FT 8
( ) FT 9
( ) FT10

Change feature
=> Feature : P1/A

!/, 012
3456789
ABCDEFG
HIJKLMN
OPQRSTU
VWXYZ-_

Appl 2:NUMERIC N_tot: 0

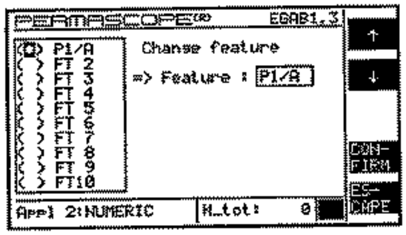
Enter the desired name of the feature.

Use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR..

☞ Use the DEL key to delete erroneous entries or unnecessary characters.

📖 On how to enter names see also Chapter 6, page 6-24.

ENTER



PERMASCOPE® EGAB1.3

(●) P1/A
( ) FT 2
( ) FT 3
( ) FT 4
( ) FT 5
( ) FT 6
( ) FT 7
( ) FT 8
( ) FT 9
( ) FT10

Change feature
=> Feature : P1/A

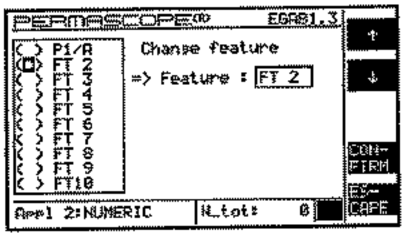
Appl 2:NUMERIC N_tot: 0

Accept the name of the feature into the list shown on the left.

☞ If no other names of features are to be entered, continue with CON-FIRM, 📖 see also page 4-13.

Define the Feature 2 (FT 2)

↓



PERMASCOPE® EGAB1.3

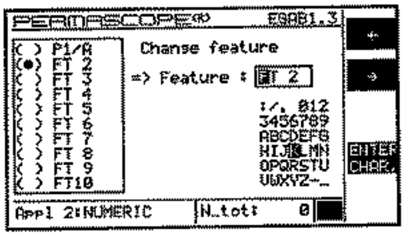
( ) P1/A
(●) FT 2
( ) FT 3
( ) FT 4
( ) FT 5
( ) FT 6
( ) FT 7
( ) FT 8
( ) FT 9
( ) FT10

Change feature
=> Feature : FT 2

Appl 2:NUMERIC N_tot: 0

Select FT 2 from the list shown on the left.

ENTER



PERMASCOPE® EGAB1.3

( ) P1/A
(●) FT 2
( ) FT 3
( ) FT 4
( ) FT 5
( ) FT 6
( ) FT 7
( ) FT 8
( ) FT 9
( ) FT10

Change feature
=> Feature : FT 2

!/, 012
3456789
ABCDEFG
HIJKLMN
OPQRSTU
VWXYZ-_

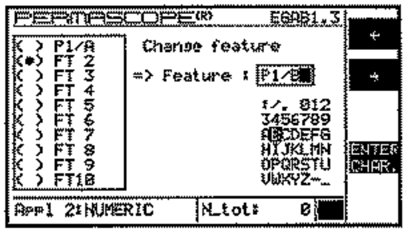
Appl 2:NUMERIC N_tot: 0

Confirm the selected feature (FT 2) and highlighted alphanumeric character of the character selection field.

Key Sequence **Display** **Comments**

Define the Feature 2 (FT 2)

▼2, ◀4, 6▶, ▲8, ENTER CHAR.



```
PERMASCOPE(R)          EGAB1.3
( ) P1/A    Change feature
(•) FT 2   => Feature : P1/B
( ) FT 3
( ) FT 4                 :/. 012
( ) FT 5                 3456789
( ) FT 6                 ABCDEFG
( ) FT 7                 HIJKLMN
( ) FT 8                 OPQRSTU
( ) FT 9                 VWXYZ-_
( ) FT10
Appl 2:NUMERIC     N_tot:      0
```

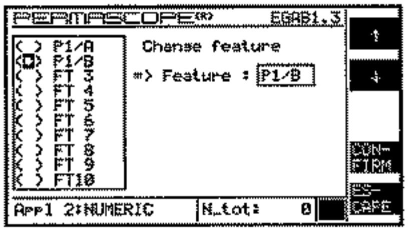
Enter the desired name of the feature.

Use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR..

☞ Use the DEL key to delete erroneous entries or unnecessary characters.

On how to enter names see also Chapter 6, page 6-24.

ENTER



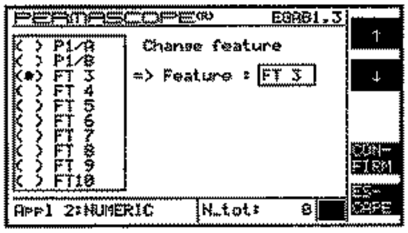
```
PERMASCOPE(R)          EGAB1.3
( ) P1/A    Change feature
(□) P1/B   => Feature : P1/B
( ) FT 3
( ) FT 4
( ) FT 5
( ) FT 6
( ) FT 7
( ) FT 8
( ) FT 9
( ) FT10
Appl 2:NUMERIC     N_tot:      0
```

Accept the name of the feature into the list shown on the left.

☞ If no other names of features are to be entered, continue with CON-FIRM, see also page 4-13.

Define the Feature 3 (FT 3)

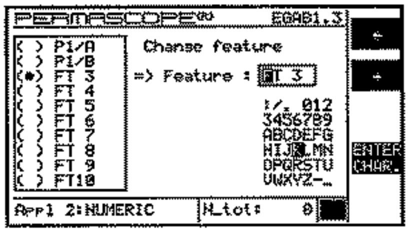
↓



```
PERMASCOPE(R)          EGAB1.3
( ) P1/A    Change feature
( ) P1/B   => Feature : FT 3
(•) FT 3
( ) FT 4
( ) FT 5
( ) FT 6
( ) FT 7
( ) FT 8
( ) FT 9
( ) FT10
Appl 2:NUMERIC     N_tot:      0
```

Select FT 3 from the list shown on the left.

ENTER



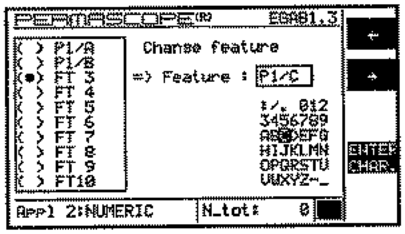
```
PERMASCOPE(R)          EGAB1.3
( ) P1/A    Change feature
( ) P1/B   => Feature : FT 3
(•) FT 3
( ) FT 4                 :/. 012
( ) FT 5                 3456789
( ) FT 6                 ABCDEFG
( ) FT 7                 HIJKLMN
( ) FT 8                 OPQRSTU
( ) FT 9                 VWXYZ-_
( ) FT10
Appl 2:NUMERIC     N_tot:      0
```

Confirm the selected feature (FT 3) and highlighted alphanumeric character of the character selection field.

Key Sequence **Display** **Comments**

Define the Feature 3 (FT 3)

▼2, ◀4, 6▶, ▲8, ENTER CHAR.



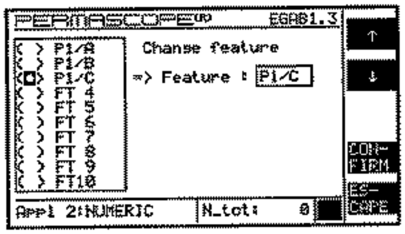
Enter the desired name of the feature.

Use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR..

☞ Use the DEL key to delete erroneous entries or unnecessary characters.

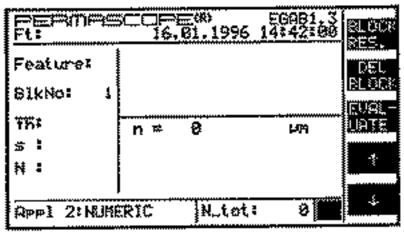
On how to enter names see also Chapter 6, page 6-24.

ENTER



Accept the name of the feature into the list shown on the left.

CON-FIRM



Accept and save the names of the features listed on the left hand side.

Change to the measurement mode of the active application.

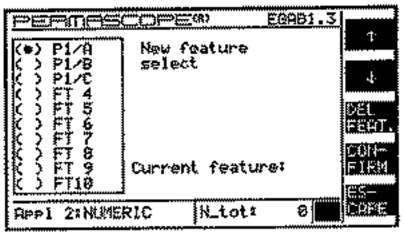
Assigning features to a measurement series (block):

Select the desired feature prior to making the first measurement of a block. The selected feature will be assigned automatically with the first measurement of the block.

Key Sequence **Display** **Comments**

Assigning FT 1

6▶ MENU



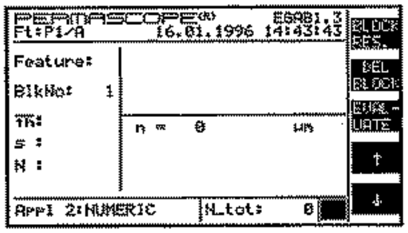
Call menu function 6 "Select Feature".

The respective menu will open.

Key Sequence **Display** **Comments**

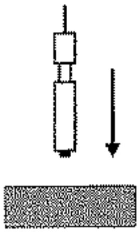
Assigning Feature 1 (P1/A)

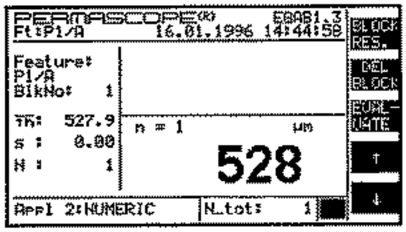
CON-FIRM



```
PERMASCOPE(R)          EGAB1.3
Ft:P1/A       16.01.1996 14:43:43
Feature:
BlkNo:     1
Th:
s :           n =    0         µm
N :
Appl 2:NUMERIC     N_tot:     0
```

Confirm the selected feature (P1/A), changes to the measurement mode of the active application.

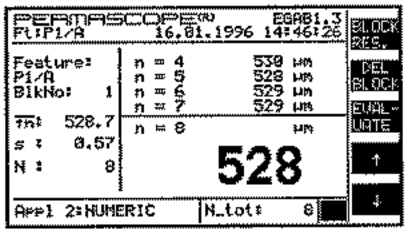




```
PERMASCOPE(R)          EGAB1.3
Ft:P1/A       16.01.1996 14:44:58
Feature:
P1/A
BlkNo:     1
Th:   527.9   n = 1           µm
s :    0.00
N :       1          528
Appl 2:NUMERIC     N_tot:     1
```

With the first measurement of the block (1), the selected feature P1/A is automatically assigned to block number 1.

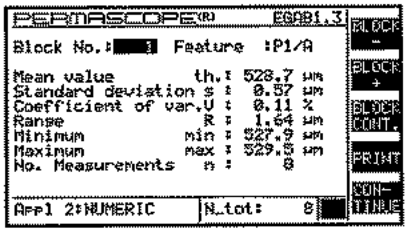
BLOCK RES.



```
PERMASCOPE(R)          EGAB1.3
Ft:P1/A       16.01.1996 14:46:26
Feature:      n = 4        530 µm
P1/A          n = 5        528 µm
BlkNo:     1  n = 6        529 µm
              n = 7        529 µm
Th:   528.7   n = 8            µm
s :    0.57
N :       8          528
Appl 2:NUMERIC     N_tot:     8
```

Continue making measurements to the last reading of the block.

Concludes the first block.



```
PERMASCOPE(R)          EGAB1.3
Block No.:    1  Feature  :P1/A
Mean value           th.: 528.7 µm
Standard deviation s :   0.57 µm
Coefficient of var.V :   0.11 %
Range                R :   1.64 µm
Minimum            min : 527.9 µm
Maximum            max : 529.5 µm
No. Measurements     n :      8
Appl 2:NUMERIC     N_tot:     8
```

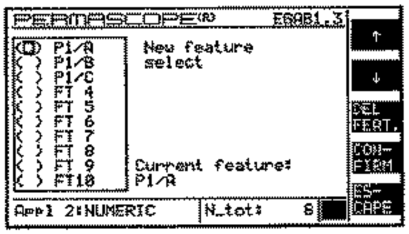
The block result for block no. 1 will appear on the display.

CON-TINUE

Return to the measurement mode.

Assigning Feature 2 (P1/B)

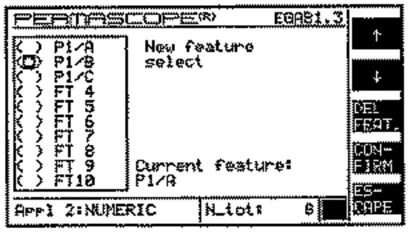
6▶ **MENU**



```
PERMASCOPE(R)          EGAB1.3
(●) P1/A     New feature
( ) P1/B     select
( ) P1/C
( ) FT 4
( ) FT 5
( ) FT 6
( ) FT 7
( ) FT 8
( ) FT 9    Current feature:
( ) FT10    P1/A
Appl 2:NUMERIC     N_tot:     8
```

Call menu function number 6 "Select Feature" before making the first measurement of the second block (number 2).

↓



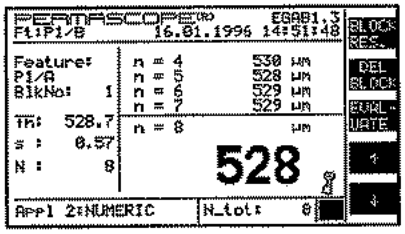
```
PERMASCOPE(R)          EGAB1.3
( ) P1/A     New feature
(●) P1/B     select
( ) P1/C
( ) FT 4
( ) FT 5
( ) FT 6
( ) FT 7
( ) FT 8
( ) FT 9    Current feature:
( ) FT10    P1/A
Appl 2:NUMERIC     N_tot:     8
```

Select the next feature (P1/B) that is to be assigned to the second block of the NUMERIC application.

Key Sequence **Display** **Comments**

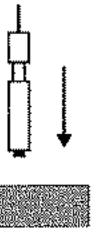
Assigning Feature 2 (P1/B)

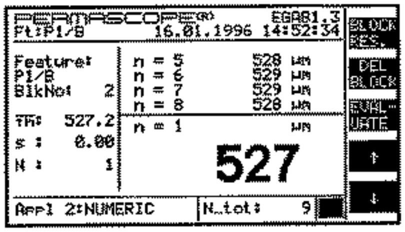
CON-FIRM



```
PERMASCOPE®                  EGAB1.3
Ft:P1/B         16.01.1996 14:51:48
Feature:   n = 4           530 µm
P1/A       n = 5           528 µm
BlkNo:   1 n = 6           529 µm
           n = 7           529 µm
Th:  528.7 n = 8               µm
s :   0.57
N :      8                528
Appl 2:NUMERIC      N_tot:    8
```

Confirm the selected feature (P1/B), changes to the measurement mode of the active application.

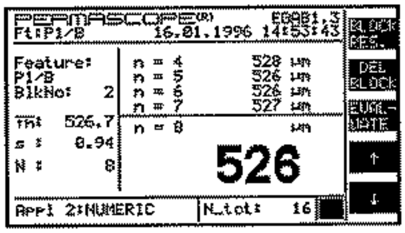




```
PERMASCOPE®                  EGAB1.3
Ft:P1/B         16.01.1996 14:52:34
Feature:   n = 5           528 µm
P1/B       n = 6           529 µm
BlkNo:   2 n = 7           529 µm
           n = 8           528 µm
Th:  527.2 n = 1               µm
s :   0.00
N :      1                527
Appl 2:NUMERIC      N_tot:    9
```

With the first measurement of the second block (2), the selected feature P1/B is automatically assigned to block number 2.

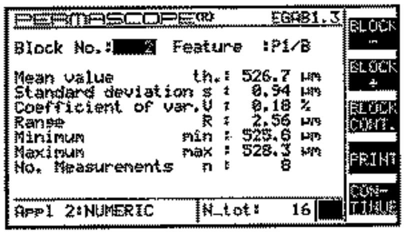
BLOCK RES.



```
PERMASCOPE®                  EGAB1.3
Ft:P1/B         16.01.1996 14:53:43
Feature:   n = 4           528 µm
P1/B       n = 5           526 µm
BlkNo:   2 n = 6           526 µm
           n = 7           527 µm
Th:  526.7 n = 8               µm
s :   0.94
N :      8                526
Appl 2:NUMERIC      N_tot:   16
```

Continue making measurements to the last reading of the block.

Concludes the second block.



```
PERMASCOPE®                  EGAB1.3
Block No.:   2   Feature    :P1/B

Mean value              th.: 526.7 µm
Standard deviation s       :   0.94 µm
Coefficient of var.V       :   0.18 %
Range                   R  :   2.56 µm
Minimum               min  : 525.6 µm
Maximum               max  : 528.3 µm
No. Measurements        n  :      8

Appl 2:NUMERIC      N_tot:   16
```

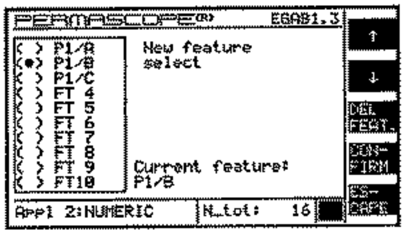
The block result for block no. 2 will appear on the display.

CON-TINUE

Return to the measurement mode.

Assigning feature 3 (P1/C)

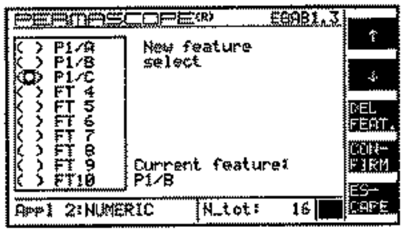
6▶ **MENU**



```
PERMASCOPE®                  EGAB1.3
( ) P1/A     New feature
(●) P1/B     select
( ) P1/C
( ) FT 4
( ) FT 5
( ) FT 6
( ) FT 7
( ) FT 8
( ) FT 9    Current feature:
( ) FT10    P1/B
Appl 2:NUMERIC      N_tot:   16
```

Call menu function number 6 "Select Feature" before making the first measurement of the third block (number 2).

↓



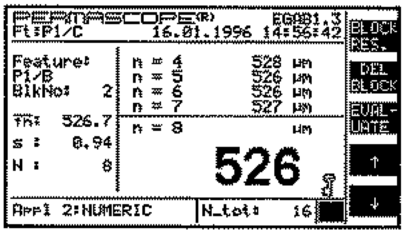
```
PERMASCOPE®                  EGAB1.3
( ) P1/A     New feature
( ) P1/B     select
(○) P1/C
( ) FT 4
( ) FT 5
( ) FT 6
( ) FT 7
( ) FT 8
( ) FT 9    Current feature:
( ) FT10    P1/B
Appl 2:NUMERIC      N_tot:   16
```

Select the next feature (P1/C) that is to be assigned to the second block of the NUMERIC application.

Key Sequence **Display** **Comments**

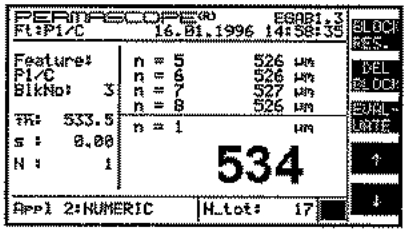
Assigning Feature 3 (P1/C)

CON-FIRM



```
PERMASCOPE(R)                EGAB1.3   BLOCK
Ft:P1/C          16.01.1996 14:56:42   RES.
Feature:   n = 4           528 µm      DEL
P1/B       n = 5           526 µm      BLOCK
BlkNo:   2 n = 6           526 µm      EVAL-
           n = 7           527 µm      UATE
TH:  526.7 n = 8               µm       ↑
s :   0.94
N :      8                526           ↓
Appl 2:NUMERIC      N_tot:     16
```

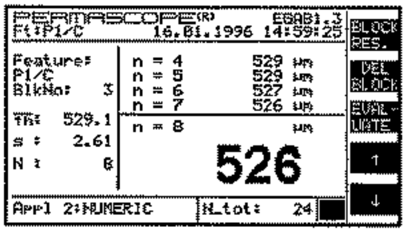
Confirm the selected feature (P1/C), changes to the measurement mode of the active application.



```
PERMASCOPE(R)                EGAB1.3   BLOCK
Ft:P1/C          16.01.1996 14:58:35   RES.
Feature:   n = 5           526 µm      DEL
P1/C       n = 6           526 µm      BLOCK
BlkNo:   3 n = 7           527 µm      EVAL-
           n = 8           526 µm      UATE
TH:  533.5 n = 1               µm       ↑
s :   0.00
N :      1                534           ↓
Appl 2:NUMERIC      N_tot:     17
```

With the first measurement of the third block (3), the selected feature P1/C is automatically assigned to block number 3.

BLOCK RES.



```
PERMASCOPE(R)                EGAB1.3   BLOCK
Ft:P1/C          16.01.1996 14:59:25   RES.
Feature:   n = 4           529 µm      DEL
P1/C       n = 5           529 µm      BLOCK
BlkNo:   3 n = 6           527 µm      EVAL-
           n = 7           526 µm      UATE
TH:  529.1 n = 8               µm       ↑
s :   2.61
N :      8                526           ↓
Appl 2:NUMERIC      N_tot:     24
```

Continue making measurements to the last reading of the block.

For a description of menu function 6 "Select Feature" and 7 "Change Feature" see Chapter 6.

Example 3 PERMASCOPE®

Measurement of the coating thickness (chrome) on connecting rods (steel). The expected coating thickness is approx. 9 µm (0.36 mils).

Application:
- Mark outlier measurements
- Monitor specification limits
- 13 measurements per block
- Combine 3 blocks for an evaluation with automatic printout
- Normalize measuring system for application

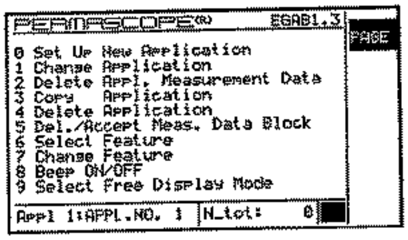
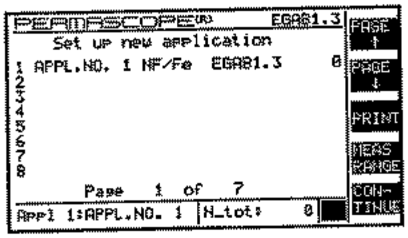
A **new Application will be created** for the measurement application of example #3. The appropriate **parameters need to be entered. Normalization** is performed **on an uncoated connecting rod.**

For a description of the measurement presentation mode "Numeric Display", see Chapter 5, Section "Numeric Display".

For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys see Chapter 6.

Preparation:
- A model EGAB1.3 magnetic induction probe is suitable for this measurement application.
- Connect the probe to the MMS®.
- Switch the MMS® on, **ON** key.

Setting-Up an Application

Key Sequence	**Display**	**Comments**
MENU		Calls the menu function screen. A list of all menu functions is displayed covering several pages.
0 **ENTER**		Enter the number 0 to open the menu function "Set-Up New Application". A screen with page 1 of all previously created applications appears.

Display after **MENU**:

```
PERMASCOPE®                    EGAB1.3
0 Set Up New Application
1 Change Application
2 Delete Appl. Measurement Data
3 Copy   Application
4 Delete Application
5 Del./Accept Meas. Data Block
6 Select Feature
7 Change Feature
8 Beep ON/OFF
9 Select Free Display Mode
Appl 1:APPL.NO. 1  N_tot:        0
```

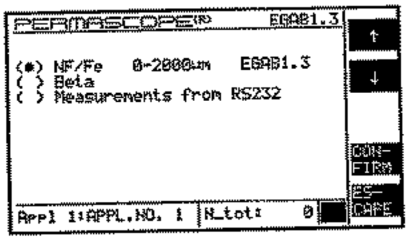
Display after **0** **ENTER**:

```
PERMASCOPE®                    EGAB1.3
    Set up new application
1 APPL.NO. 1 NF/Fe  EGAB1.3        0
2
3
4
5
6
7
8
        Page   1  of   7
Appl 1:APPL.NO. 1  N_tot:        0
```

Setting-Up an Application / Probe Selection / Entering Names

Key Sequence	Display	Comments

▼2 **ENTER**



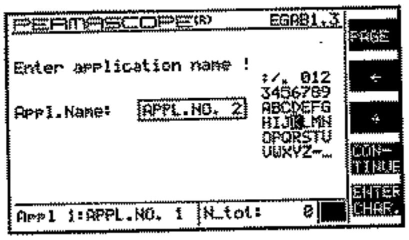
```
PERMASCOPE(R)                     EGAB1.3
(*) NF/Fe    0-2000um    EGAB1.3
( ) Beta
( ) Measurements from RS232

Appl 1:APPL.NO. 1    N_tot:        0
```

Enter the number for the new application.

The instrument searches for connected probe models and displays them in a list.

☞ If the MMS® contains a BETASCOPE® MMS® plug-in testing module (602-267) Beta (for beta emitter) will always be displayed in the list.

CON-FIRM

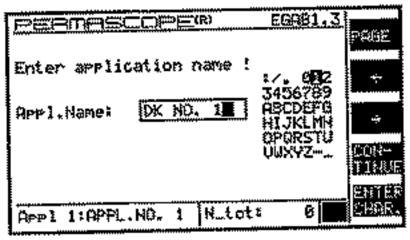


```
PERMASCOPE(R)                     EGAB1.3
Enter application name !       :/, 012
                               3456789
Appl.Name:    APPL.NO. 2       ABCDEFG
                               HIJKLMN
                               OPQRSTU
                               VWXYZ-_

Appl 1:APPL.NO. 1    N_tot:        0
```

Select the probe model (NE/Fe ...).

A screen to enter the name of the application will be displayed.

▼2, **◀4**, **6▶**, **▲8**, **ENTER CHAR.**



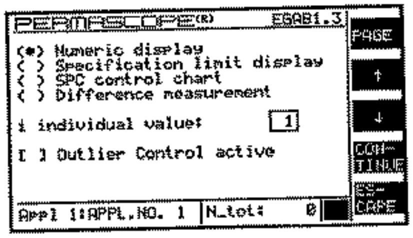
```
PERMASCOPE(R)                     EGAB1.3
Enter application name !       :/, 012
                               3456789
Appl.Name:    DK NO. 1         ABCDEFG
                               HIJKLMN
                               OPQRSTU
                               VWXYZ-_

Appl 1:APPL.NO. 1    N_tot:        0
```

In our example: DK NO. 1
Use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR..

☞ Use the DEL key to delete erroneous entries or unnecessary characters.

On how to enter names see also Chapter 6, page 6-24.

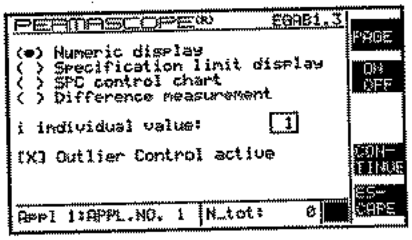
PAGE



```
PERMASCOPE(R)                     EGAB1.3
(*) Numeric display
( ) Specification limit display
( ) SPC control chart
( ) Difference measurement

i individual value:          1

[ ] Outlier Control active

Appl 1:APPL.NO. 1    N_tot:        0
```

Open the next menu page to make additional selections.

ENTER **ENTER** **ON OFF**



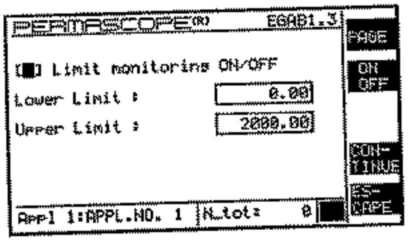
```
PERMASCOPE(R)                     EGAB1.3
(*) Numeric display
( ) Specification limit display
( ) SPC control chart
( ) Difference measurement

i individual value:          1

[X] Outlier Control active

Appl 1:APPL.NO. 1    N_tot:        0
```

Activate outlier monitoring.

Setting-Up an Application / Defining Parameters

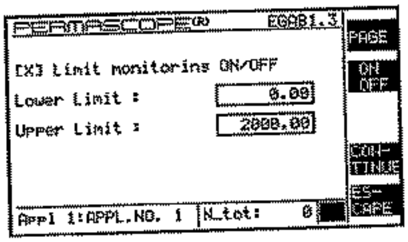
Key Sequence **Display** **Comments**

PAGE


PERMASCOPE® EGAB1.3
[■] Limit monitoring ON/OFF
Lower Limit : 0.00
Upper Limit : 2000.00
Appl 1:APPL.NO. 1 | N_tot: 0

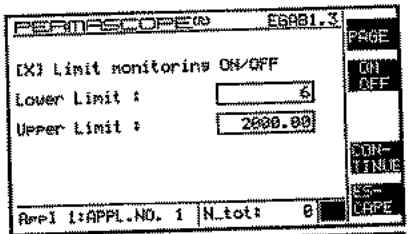
Open the next menu page to make additional selections.

ON OFF


PERMASCOPE® EGAB1.3
[X] Limit monitoring ON/OFF
Lower Limit : 0.00
Upper Limit : 2000.00
Appl 1:APPL.NO. 1 | N_tot: 0

Activate specification limit monitoring (audible signal for upper and lower limit violations).

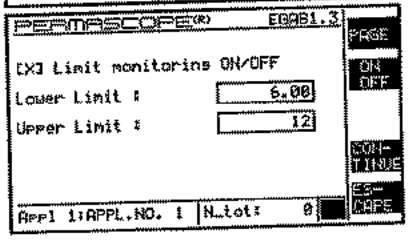
ENTER **6▶**


PERMASCOPE® EGAB1.3
[X] Limit monitoring ON/OFF
Lower Limit : 6
Upper Limit : 2000.00
Appl 1:APPL.NO. 1 | N_tot: 0

Enter the lower specification limit (6 µm).

☞ Use the **DEL** key to delete erroneous entries.

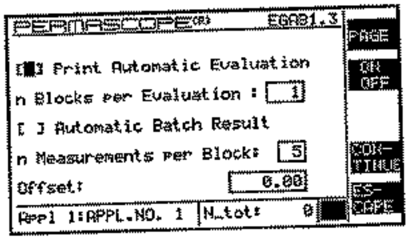
ENTER **1**
▼2


PERMASCOPE® EGAB1.3
[X] Limit monitoring ON/OFF
Lower Limit : 6.00
Upper Limit : 12
Appl 1:APPL.NO. 1 | N_tot: 0

Enter the upper specification limit (12 µm).

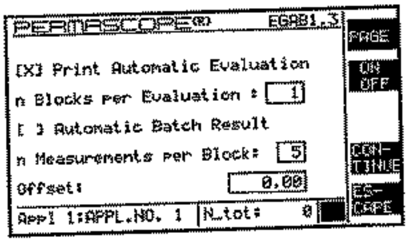
☞ Use the **DEL** key to delete erroneous entries.

PAGE


PERMASCOPE® EGAB1.3
[■] Print Automatic Evaluation
n Blocks per Evaluation : 1
[ ] Automatic Batch Result
n Measurements per Block: 5
Offset: 0.00
Appl 1:APPL.NO. 1 | N_tot: 0

Open the next menu page to make additional selections.

ON OFF

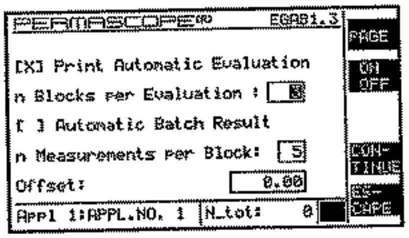

PERMASCOPE® EGAB1.3
[X] Print Automatic Evaluation
n Blocks per Evaluation : 1
[ ] Automatic Batch Result
n Measurements per Block: 5
Offset: 0.00
Appl 1:APPL.NO. 1 | N_tot: 0

Activate automatic evaluation printing.

Key Sequence **Display** **Comments**

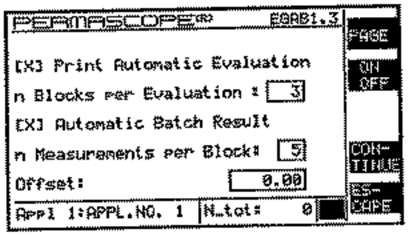
Setting-Up an Application / Defining Parameters

ENTER **3**


PERMASCOPE® EGAB1.3
[X] Print Automatic Evaluation
n Blocks per Evaluation : 3
[ ] Automatic Batch Result
n Measurements per Block: 5
Offset: 0.00
Appl 1:APPL.NO. 1 N_tot: 0

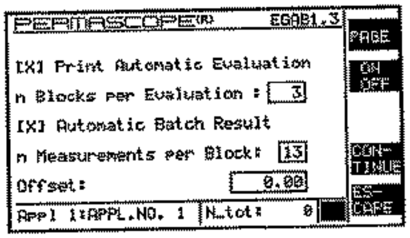
Enter the number of blocks (3) to be combined for an (automatic) evaluation printing.

ENTER **ON OFF**


PERMASCOPE® EGAB1.3
[X] Print Automatic Evaluation
n Blocks per Evaluation : 3
[X] Automatic Batch Result
n Measurements per Block: 5
Offset: 0.00
Appl 1:APPL.NO. 1 N_tot: 0

Activate the automatic batch result.

ENTER **1** **3**

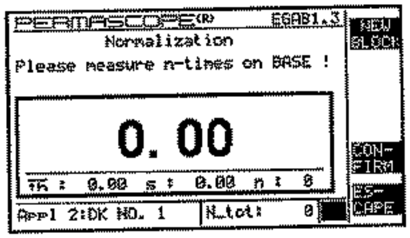

PERMASCOPE® EGAB1.3
[X] Print Automatic Evaluation
n Blocks per Evaluation : 3
[X] Automatic Batch Result
n Measurements per Block: 13
Offset: 0.00
Appl 1:APPL.NO. 1 N_tot: 0

Enter the number of measurements (13) per block (batch).

A new block and block (batch) result is generated automatically after 13 measurements.

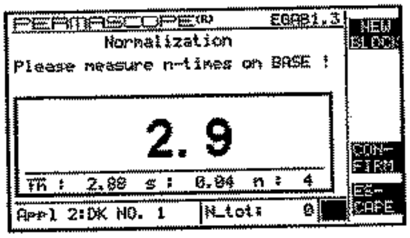
Setting-Up an Application / Normalization

CON-TINUE


PERMASCOPE® EGAB1.3
Normalization
Please measure n-times on BASE !
0.00
TR : 0.00 s : 0.00 n : 0
Appl 2:DK NO. 1 N_tot: 0

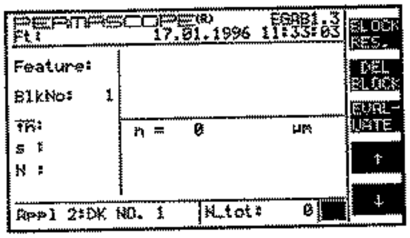
Finish parameter definition and change to the normalization function.

Measure n times on the uncoated specimen (connecting rod).


PERMASCOPE® EGAB1.3
Normalization
Please measure n-times on BASE !
2.9
TR : 2.88 s : 0.04 n : 4
Appl 2:DK NO. 1 N_tot: 0

Repeat the measurement until the reading changes only slightly or not at all.

CON-FIRM


PERMASCOPE® EGAB1.3
Ft: 17.01.1996 11:33:03
Feature:
BlkNo: 1
TR:
s :
N :
n = 0 µm
Appl 2:DK NO. 1 N_tot: 0

Save the application, change to the measurement mode of the newly created Application Number 2, DK NO. 1.

You are now ready to start the measurement process. If the printer is ON, an evaluation result will be printed for each 3 blocks.

☞ We recommend to make reference measurements prior to actual measurements to prevent measurements errors.
For greater details see Chapter 6.

Example 4 PERMASCOPE®

Measurement of the coating thickness on connecting rods in example 3, but with different parameter settings.

Application:
- Mark outlier measurements (same as in example 3)
- Monitor specification limits (same as in example 3)
- 39 measurements per block
- Evaluation after every block with automatic printout
- Document block result and print out single readings
- Same normalization (calibration) as in example # 3

A **separate application must be created** for example #4. To be able to use the calibration of example #3, the created **Application number 2**, DK NO. 1, must be **copied** and the **parameter settings changed** according to the above measurement application.

☞ A copied application contains the normalization and calibration parameters, probe characteristics, and all settings of the original application. The measurements, however, are not copied. The application should be given a new name.

☞ The same probe used in the original application must be used in the copied application, since the probe characteristics and the calibration parameters are copied as well.

For a description of the measurement presentation mode "Numeric Display", see Chapter 5, Section "Numeric Display".

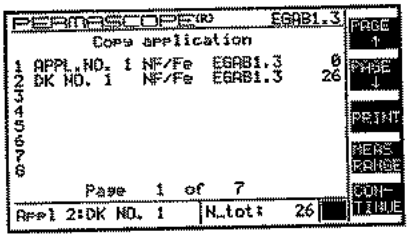
For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys see Chapter 6.

Preparation:
- Connect the same probe to the MMS® that was used for example 3 (EGAB1.3).
- Switch the MMS® on, ON key.

Copy Application

Key Sequence | **Display** | **Comments**

MENU **3**
ENTER

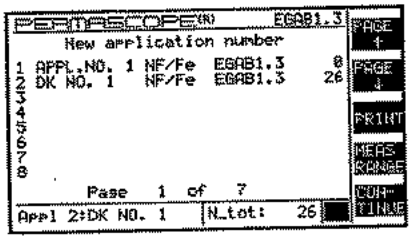


```
PERMASCOPE(R)                 EGAB1.3
          Copy application
1 APPL.NO. 1 NF/Fe  EGAB1.3        0
2 DK NO. 1   NF/Fe  EGAB1.3       26
3
4
5
6
7
8
        Page   1  of   7
Appl 2:DK NO. 1   |N.tot:     26
```

Calls menu function 3 "Copy Application".

A screen with page 1 of all previously created applications appears.

▼2 **ENTER**



```
PERMASCOPE(R)                 EGAB1.3
      New application number
1 APPL.NO. 1 NF/Fe  EGAB1.3        0
2 DK NO. 1   NF/Fe  EGAB1.3       26
3
4
5
6
7
8
        Page   1  of   7
Appl 2:DK NO. 1   |N_tot:     26
```

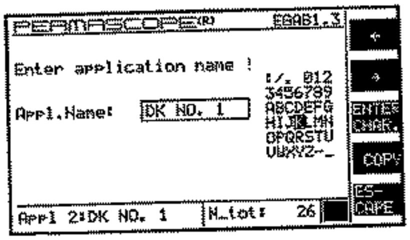
Enter the number of the application whose parameters etc. are to be copied.

A screen with page 1 of the previously created applications appears.

Key Sequence **Display** **Comments**

Copy Application / Enter Name

3 ENTER



Enter application name !

Appl.Name: DK NO. 1

:/. 012
3456789
ABCDEFG
HIJKLMN
OPQRSTU
VWXYZ-_

Appl 2:DK NO. 1 N_tot: 26

Enter a new number for the (copied) application to save the copied parameters etc. in.

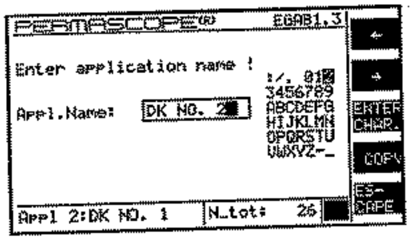
A screen to enter the name of the new application appears.

☞ The name of the original application is displayed automatically by the MMS®.

→ ▼2

◀4 6▶

▲8 ENTER CHAR.



Enter application name !

Appl.Name: DK NO. 2

:/. 012
3456789
ABCDEFG
HIJKLMN
OPQRSTU
VWXYZ-_

Appl 2:DK NO. 1 N_tot: 26

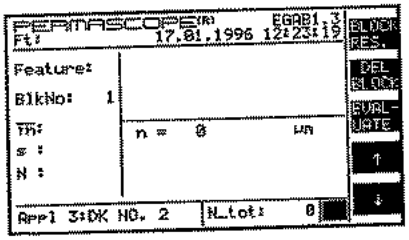
Enter the name for the new application (DK NO. 2).

Use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR.

☞ Use the DEL key to delete erroneous entries or unnecessary characters.

On how to enter names see also Chapter 6, page 6-24.

COPY



Ft: 17.01.1996 12:23:19

Feature:

BlkNo: 1

T̄h:

s :

N :

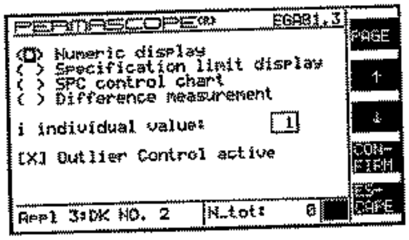
n = 0 µm

Appl 3:DK NO. 2 N_tot: 0

Initiate the copy procedure, change to the measuring mode of the newly created application number 3, DK NO. 2.

Change Application / Define Parameters

1 MENU



(●) Numeric display
( ) Specification limit display
( ) SPC control chart
( ) Difference measurement

i individual value: 1

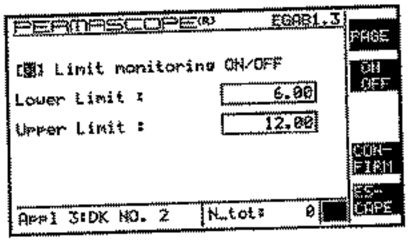
[X] Outlier Control active

Appl 3:DK NO. 2 N_tot: 0

Opens menu function 1, "Change Application".

The first page of this menu function appears. For this example, the parameters will not be changed.

PAGE



[■] Limit monitoring ON/OFF

Lower Limit : 6.00

Upper Limit : 12.00

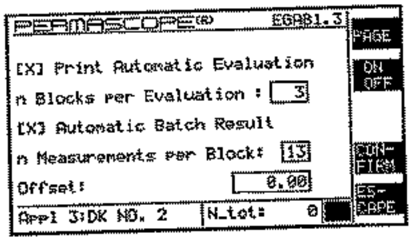
Appl 3:DK NO. 2 N_tot: 0

Turn to the next menu page. For this example, the parameters will not be changed.

Key Sequence **Display** **Comments**

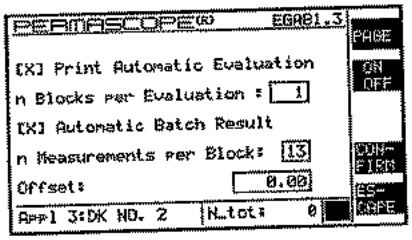
Change Application / Define Parameters

PAGE


```
PERMASCOPE®                    EGAB1.3
[X] Print Automatic Evaluation
n Blocks per Evaluation : [  3]
[X] Automatic Batch Result
n Measurements per Block: [13]
Offset:                  [  0.00]
Appl 3:DK NO. 2     |N_tot:      0
```

Turn to the next menu page.
Change the parameters on this page according to the measurement application requirement.

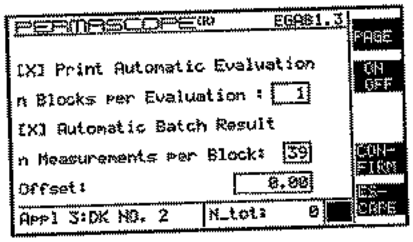
ENTER **1**


```
PERMASCOPE®                    EGAB1.3
[X] Print Automatic Evaluation
n Blocks per Evaluation : [  1]
[X] Automatic Batch Result
n Measurements per Block: [13]
Offset:                  [  0.00]
Appl 3:DK NO. 2     |N_tot:      0
```

Enter the number of the blocks (1) for automatic evaluation printing.

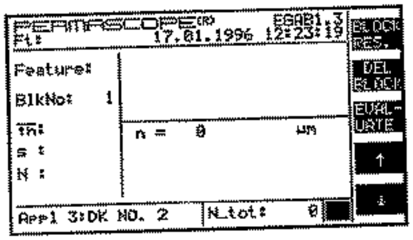
ENTER **ENTER**

3 **9**


```
PERMASCOPE®                    EGAB1.3
[X] Print Automatic Evaluation
n Blocks per Evaluation : [  1]
[X] Automatic Batch Result
n Measurements per Block: [39]
Offset:                  [  0.00]
Appl 3:DK NO. 2     |N_tot:      0
```

Enter the number of measurements per block (39).

CON-FIRM

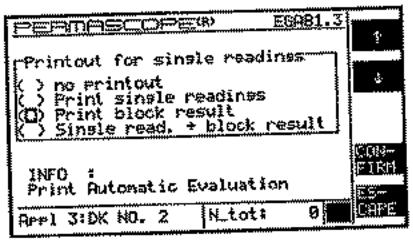

```
PERMASCOPE®                    EGAB1.3
Ft:               17.01.1996  12:23:19
Feature:
BlkNo:    1
x̄:          n =   0           µm
s :
N :
Appl 3:DK NO. 2     |N_tot:      0
```

Save the parameter changes for application number 3, DK NO. 2.

Define the Data Output

1 **0**

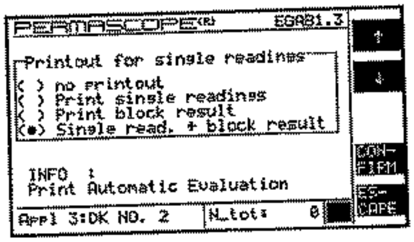
MENU


```
PERMASCOPE®                    EGAB1.3
Printout for single readings
( ) no printout
( ) Print single readings
(•) Print block result
( ) Single read. + block result

INFO  :
Print Automatic Evaluation
Appl 3:DK NO. 2     |N_tot:      0
```

Calls menu function 10, " Output To Printer".

The respective menu will open.

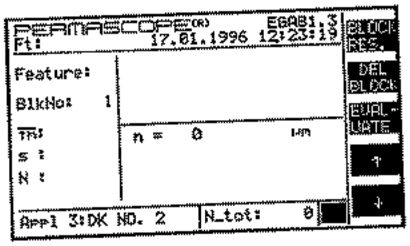
↓


```
PERMASCOPE®                    EGAB1.3
Printout for single readings
( ) no printout
( ) Print single readings
( ) Print block result
(•) Single read. + block result

INFO  :
Print Automatic Evaluation
Appl 3:DK NO. 2     |N_tot:      0
```

Use the softkey to move the selection (point) to the line "Single read. + block result".

☞ Another selection, e.g., "Print single readings" can be made, if so desired.

Define the Data Output

Key Sequence	Display	Comments
CON-FIRM	 PERMASCOPE(R) EGAB1.3 Ft: 17.01.1996 12:23:19 Feature: BlkNo: 1 n = 0 Appl 3:DK NO. 2 N_tot: 0	Save the settings of menu function 10, change to the active application (DK NO. 2).

You are now ready to start the measurement process. If the printer is ON, a block (batch) result will be printed after every 13 measurements. In addition an evaluation will be printed after every three blocks.

☞ We recommend to make reference measurements prior to actual measurements to prevent measurements errors.
   For greater details see Chapter 6.

☞ The settings of the menu function 10 apply to all applications. The function settings can be changed at any time.

Example 5 PERMASCOPE®

Measurement of a Zinc coating on steel.

Application:
- Specification limit monitoring (display presentation, acoustical)
- Documenting single readings
- Mark outlier measurements
- Normalize measuring system for application

A **new Application will be created** for the measurement application mentioned above. parameters must be entered according to the above measurement application. **Normalization** is performed directly **on** the **substrate material** (uncoated piece of steel).

For a description of the measurement presentation mode "Specification Limit Display", see Chapter 5, Section "Specification Limit Display".

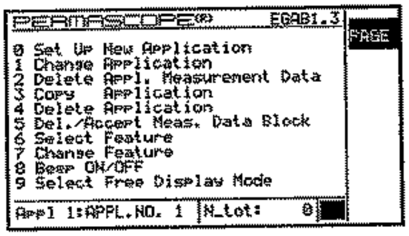
For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys see Chapter 6.

Preparation:
- A model EGAB1.3 magnetic induction probe is suitable for this measurement application.
- Connect the probe to the MMS®
- Switch the MMS® on, **ON** key

Setting-Up an Application

Key Sequence	Display	Comments

MENU

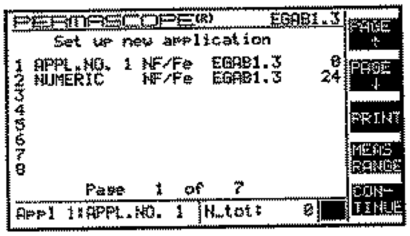


```
PERMASCOPE(R)          EGAB1.3
0 Set Up New Application
1 Change Application
2 Delete Appl. Measurement Data
3 Copy   Application
4 Delete Application
5 Del./Accept Meas. Data Block
6 Select Feature
7 Change Feature
8 Beep ON/OFF
9 Select Free Display Mode
Appl 1:APPL.NO. 1 |N_tot:     0
```

Calls the menu function screen.

A list of all menu functions is displayed covering several pages.

0 **ENTER**



```
PERMASCOPE(R)          EGAB1.3
    Set up new application
1 APPL.NO. 1 NF/Fe  EGAB1.3     0
2 NUMERIC    NF/Fe  EGAB1.3    24
3
4
5
6
7
8
        Page   1  of   7
Appl 1:APPL.NO. 1 |N_tot:     0
```

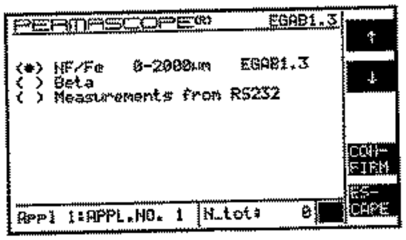
Enter the number 0 to open the menu function "Set-Up New Application".

A screen with previously created applications appears.

Setting-Up an Application / Probe Selection / Entering Names / Defining Parameters

Key Sequence | Display | Comments

3 **ENTER**



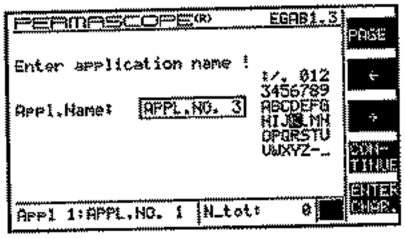
```
PERMASCOPE(R)                EGAB1.3
(*) NF/Fe   0-2000um   EGA01.3
( ) Beta
( ) Measurements from RS232

Appl 1:APPL.NO. 1  N_tot:        0
```

Enter the number for the new application.

The instrument searches for connected probe models and displays them in a list.

☞ If the MMS® contains a BETASCOPE® MMS® plug-in testing module (602-267) Beta (for beta emitter) will always be displayed in the list.

CON-FIRM

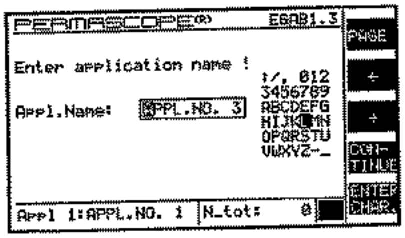


```
PERMASCOPE(R)                EGAB1.3
Enter application name !
                            ¦/, 012
                            3456789
Appl.Name:    APPL.NO. 3    ABCDEFG
                            HIJKLMN
                            OPQRSTU
                            VWXYZ-_
Appl 1:APPL.NO. 1  N_tot:        0
```

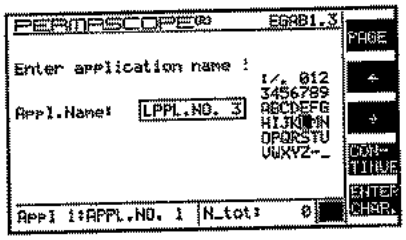
Select the probe model (NE/Fe ...).

A screen to enter the name of the application will be displayed.

▼2, **◀4**, **6▶**, **▲8**, **ENTER CHAR.**



```
PERMASCOPE(R)                EGAB1.3
Enter application name !
                            ¦/, 012
                            3456789
Appl.Name:    APPL.NO. 3    ABCDEFG
                            HIJKLMN
                            OPQRSTU
                            VWXYZ-_
Appl 1:APPL.NO. 1  N_tot:        0
```



```
PERMASCOPE(R)                EGAB1.3
Enter application name !
                            ¦/, 012
                            3456789
Appl.Name:    LPPL.NO. 3    ABCDEFG
                            HIJKLMN
                            OPQRSTU
                            VWXYZ-_
Appl 1:APPL.NO. 1  N_tot:        0
```

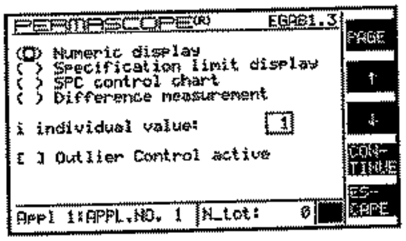
In our example: LIMIT

Use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR..

☞ Use the DEL key to delete erroneous entries or unnecessary characters.

On how to enter names see also Chapter 6, page 6-24.

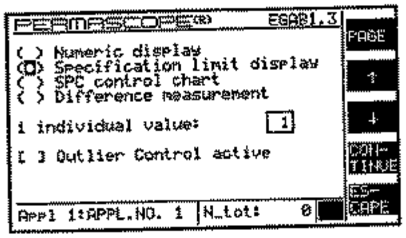
PAGE



```
PERMASCOPE(R)                EGAB1.3
(O) Numeric display
( ) Specification limit display
( ) SPC control chart
( ) Difference measurement

i individual value:          1

[ ] Outlier Control active

Appl 1:APPL.NO. 1  N_tot:        0
```

Open the next menu page to make additional selections.

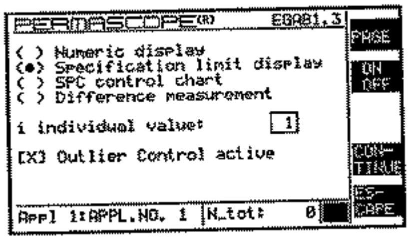
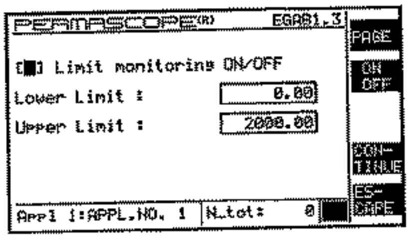
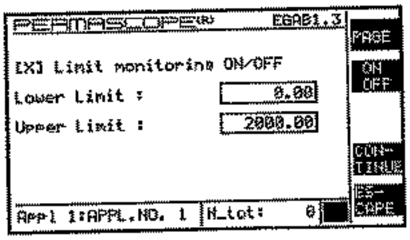
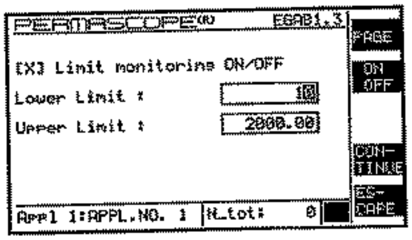
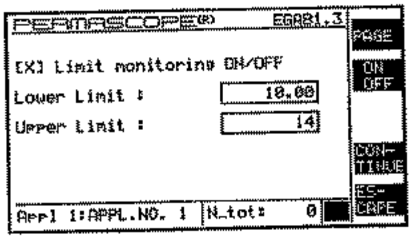
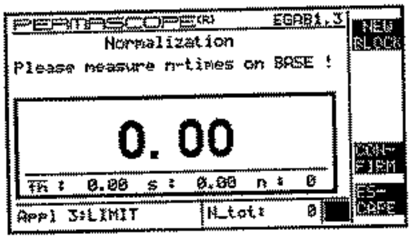
↓



```
PERMASCOPE(R)                EGAB1.3
( ) Numeric display
(O) Specification limit display
( ) SPC control chart
( ) Difference measurement

i individual value:          1

[ ] Outlier Control active

Appl 1:APPL.NO. 1  N_tot:        0
```

Select the measurement display mode "Specification limit display".

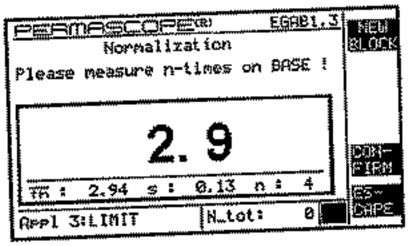
Setting-Up an Application / Defining Parameters

Key Sequence	Display	Comments
ENTER ENTER ON OFF	 PERMASCOPE(R) EGAB1.3 ( ) Numeric display (●) Specification limit display ( ) SPC control chart ( ) Difference measurement i individual value: 1 [X] Outlier Control active Appl 1:APPL.NO. 1 N_tot: 0	Activate outlier monitoring.
PAGE	 PERMASCOPE(R) EGAB1.3 [■] Limit monitoring ON/OFF Lower Limit : 0.00 Upper Limit : 2000.00 Appl 1:APPL.NO. 1 N_tot: 0	Open the next menu page to make additional selections.
ON OFF	 PERMASCOPE(R) EGAB1.3 [X] Limit monitoring ON/OFF Lower Limit : 0.00 Upper Limit : 2000.00 Appl 1:APPL.NO. 1 N_tot: 0	Activate specification limit monitoring (audible signal for upper and lower limit violations).
ENTER 1 0	 PERMASCOPE(R) EGAB1.3 [X] Limit monitoring ON/OFF Lower Limit : 10 Upper Limit : 2000.00 Appl 1:APPL.NO. 1 N_tot: 0	Enter the lower specification limit (10 µm). ☞ Use the DEL key to delete erroneous entries.
ENTER 1 ◀4	 PERMASCOPE(R) EGAB1.3 [X] Limit monitoring ON/OFF Lower Limit : 10.00 Upper Limit : 14 Appl 1:APPL.NO. 1 N_tot: 0	Enter the upper specification limit (14 µm). ☞ Use the DEL key to delete erroneous entries.
CON-TINUE	 PERMASCOPE(R) EGAB1.3 Normalization Please measure n-times on BASE ! 0.00 $\bar{x}$: 0.00 s : 0.00 n : 0 Appl 3:LIMIT N_tot: 0	Finish parameter definition and change to the normalization function.

Key Sequence **Display** **Comments**

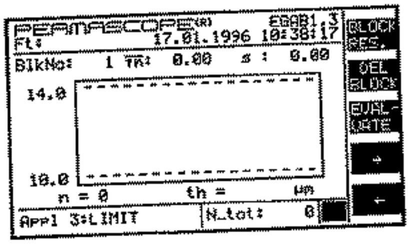
Setting-Up an Application / Normalization

Measure n times on the uncoated specimen.


```
PERMASCOPE(R)          EGAB1.3
        Normalization
Please measure n-times on BASE !

              2.9
TR :   2.94   s :  0.13   n :  4
Appl 3:LIMIT       N_tot:     0
```

Repeat the measurement until the reading changes only slightly or not at all.

CON-FIRM

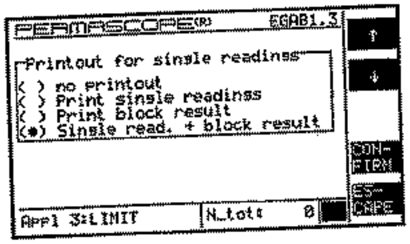

```
PERMASCOPE(R)            EGAB1.3
Ft:          17.01.1996 10:38:17
BlkNo:   1 TR:  0.00    s :  0.00
 14.0
 10.0
    n = 0        th =         µm
Appl 3:LIMIT       N_tot:     0
```

Save the application, change to the measurement mode of the newly created Application number 3, LIMIT.

Defining the Data Output

1 **0**

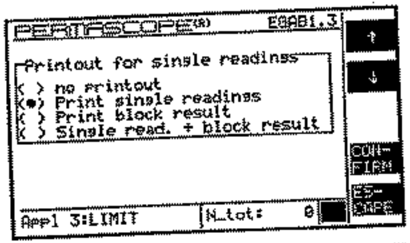
MENU


```
PERMASCOPE(R)          EGAB1.3
Printout for single readings
( ) no printout
( ) Print single readings
( ) Print block result
(●) Single read. + block result

Appl 3:LIMIT       N_tot:     0
```

Calls menu function 10, " Output To Printer".

The respective menu will open.

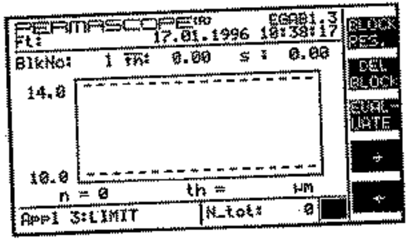
↓ **↑**


```
PERMASCOPE(R)          EGAB1.3
Printout for single readings
( ) no printout
(●) Print single readings
( ) Print block result
( ) Single read. + block result

Appl 3:LIMIT       N_tot:     0
```

Use the softkey to move the selection (point) to the line "Single read. + block result".

☞ Another selection, e.g., "Print block result" can be made, if so desired.

CON-FIRM


```
PERMASCOPE(R)            EGAB1.3
Ft:          17.01.1996 10:38:17
BlkNo:   1 TR:  0.00    s :  0.00
 14.0
 10.0
    n = 0        th =         µm
Appl 3:LIMIT       N_tot:     0
```

Save the settings of menu function 10, change to the active application (LIMIT).

You are now ready to start the measurement process. If the printer is ON, a block (batch) result will be printed after every 13 measurements.

☞ We recommend to make reference measurements prior to actual measurements to prevent measurements errors.
For greater details see Chapter 6.

☞ The settings of the menu function 10 apply to all applications. The function settings can be changed at any time.

Example 6 PERMASCOPE®

Measurement of zinc coating thickness on steel in a production line. By measuring a previous sample lot it was determined that the plating process has a normal distribution.

Application:
- SPC control chart Display
- Upper and lower control limits calculated by instrument
- Normalize Measuring System for Application

A new **Application will be created** for the measurement application mentioned above. **Upper** and **lower control limits** are **calculated by the MMS®** using a pre-trial measurement series. **Normalization** is performed directly **on** the **substrate material** (uncoated product).

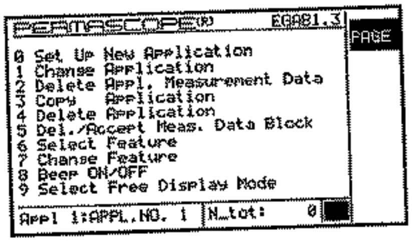
For a description of the measurement presentation mode "SPC Control Chart", see Chapter 5, Section "SPC Control Chart".

For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys see Chapter 6.

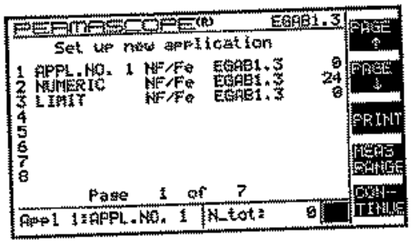
Preparation:
- A model EGAB1.3 magnetic induction probe is suitable for this measurement application.
- Connect the probe to the MMS®.
- Switch the MMS® on, **ON** key.

Setting-Up an Application

Key Sequence	**Display**	**Comments**
MENU	see first display below	Calls the menu function screen. A list of all menu functions is displayed covering several pages.
0 **ENTER**	see second display below	Enter the number 0 to open the menu function "Set-Up New Application". A screen with page 1 of all created applications appears.



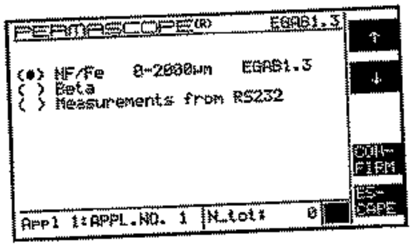
```
PERMASCOPE(R)                EGAB1.3
0 Set Up New Application
1 Change Application
2 Delete Appl. Measurement Data
3 Copy   Application
4 Delete Application
5 Del./Accept Meas. Data Block
6 Select Feature
7 Change Feature
8 Beep ON/OFF
9 Select Free Display Mode
Appl 1:APPL.NO. 1   N_tot:       0
```



```
PERMASCOPE(R)                  EGAB1.3
      Set up new application
1 APPL.NO. 1 NF/Fe  EGAB1.3        0
2 NUMERIC    NF/Fe  EGAB1.3       24
3 LIMIT      NF/Fe  EGAB1.3        0
4
5
6
7
8
          Page   1  of   7
Appl 1:APPL.NO. 1   N_tot:       0
```

Key Sequence | **Display** | **Comments**

◀4 **ENTER**



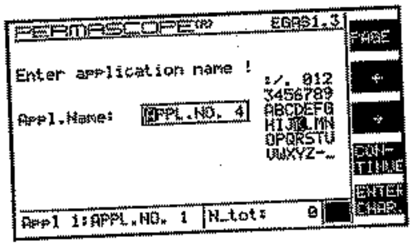
```
PERMASCOPE(R)                    EGAB1.3
(●) NF/Fe    0-2000µm   EGAB1.3
( ) Beta
( ) Measurements from RS232

Appl 1:APPL.NO. 1   N_tot:         0
```

Enter the number for the new application.

The instrument searches for connected probe models and displays them in a list.

☞ If the MMS® contains a BETASCOPE® MMS® plug-in testing module (602-267) Beta (for beta emitter) will always be displayed in the list.

CON-FIRM

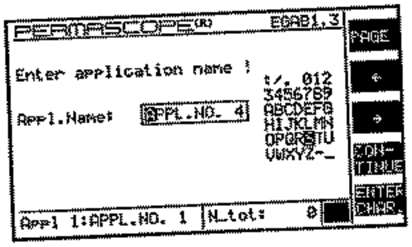


```
PERMASCOPE(R)                    EGAB1.3
Enter application name !   :/. 012
                           3456789
Appl.Name:   APPL.NO. 4    ABCDEFG
                           HIJKLMN
                           OPQRSTU
                           VWXYZ-_
Appl 1:APPL.NO. 1   N_tot:         0
```

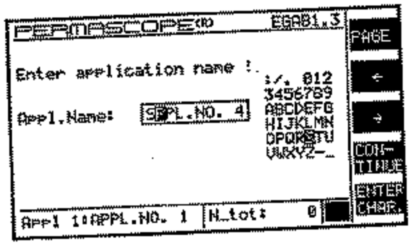
Select the probe model (NE/Fe ...).

A screen to enter the name of the application will be displayed.

▼2, **◀4**, **6▶**, **▲8**, **ENTER CHAR.**



```
PERMASCOPE(R)                    EGAB1.3
Enter application name !   :/. 012
                           3456789
Appl.Name:   APPL.NO. 4    ABCDEFG
                           HIJKLMN
                           OPQRSTU
                           VWXYZ-_
Appl 1:APPL.NO. 1   N_tot:         0
```



```
PERMASCOPE(R)                    EGAB1.3
Enter application name !   :/. 012
                           3456789
Appl.Name:   SPPL.NO. 4    ABCDEFG
                           HIJKLMN
                           OPQRSTU
                           VWXYZ-_
Appl 1:APPL.NO. 1   N_tot:         0
```

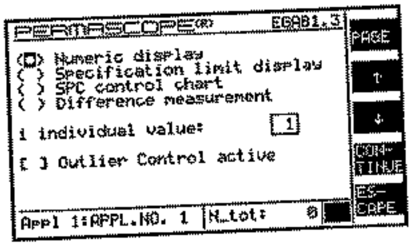
In our example: SPC

Use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR..

☞ Use the DEL key to delete erroneous entries or unnecessary characters.

On how to enter names see also Chapter 6, page 6-24.

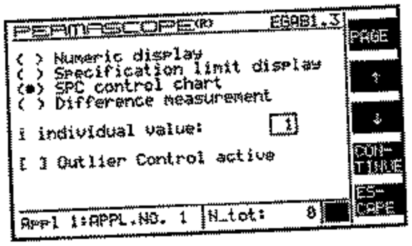
PAGE



```
PERMASCOPE(R)                    EGAB1.3
(●) Numeric display
( ) Specification limit display
( ) SPC control chart
( ) Difference measurement

i individual value:     [1]

[ ] Outlier Control active

Appl 1:APPL.NO. 1   N_tot:         0
```

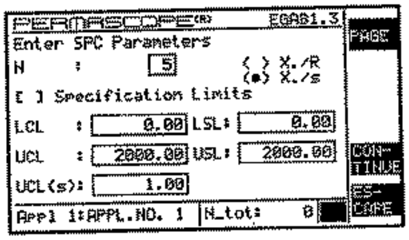
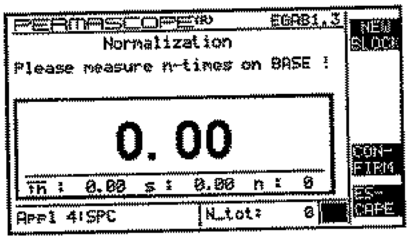
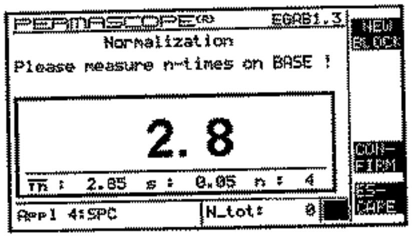
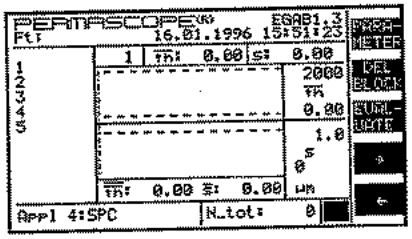
Open the next menu page to make additional selections.

↓ **↓**



```
PERMASCOPE(R)                    EGAB1.3
( ) Numeric display
( ) Specification limit display
(●) SPC control chart
( ) Difference measurement

i individual value:     [1]

[ ] Outlier Control active

Appl 1:APPL.NO. 1   N_tot:         0
```

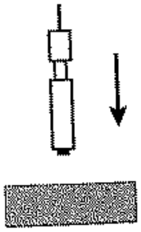
Select the measurement display mode "SPC control chart".

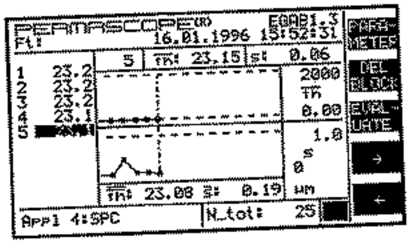
	Key Sequence	Display	Comments
Setting-Up an Application / Parameter Definition	**PAGE**	 PERMASCOPE® EGAB1.3 Enter SPC Parameters N : 5 ( ) X./R (●) X./s [ ] Specification Limits LCL : 0.00 LSL: 0.00 UCL : 2000.00 USL: 2000.00 UCL(s): 1.00 Appl 1:APPL.NO. 1 N_tot: 0 	Open the next menu page to make additional selections.
	0 . . . **9** **ENTER** **↓** **ON OFF**		Enter the number of parts for the subgroup size and the type of chart to be displayed (X./R or X./s). If known, control limits or (if so desired) specification limits may be entered/selected. Use the **DEL** key to delete erroneous entries. On how to enter names see also Chapter 6, page 6-24.
Setting-Up an Application / Normalization	**CON-TINUE**	 PERMASCOPE® EGAB1.3 Normalization Please measure n-times on BASE ! 0.00 $\overline{th}$: 0.00 s : 0.00 n : 0 Appl 4:SPC N_tot: 0 	Finish parameter definition and change to the normalization function.
	Measure n times on the uncoated specimen.	 PERMASCOPE® EGAB1.3 Normalization Please measure n-times on BASE ! 2.8 $\overline{th}$: 2.85 s : 0.05 n : 4 Appl 4:SPC N_tot: 0 	Repeat the measurement until the reading changes only slightly or not at all.
	CON-FIRM	 PERMASCOPE® EGAB1.3 Ft: 16.01.1996 15:51:23 1 $\overline{th}$: 0.00 s: 0.00 $\overline{th}$: 0.00 $\overline{s}$: 0.00 Appl 4:SPC N_tot: 0 	Save the application, change to the measurement mode of the newly created Application Number 4, SPC.

The MMS® needs a minimum of 5 subgroups to calculate the control limits.

Key Sequence **Display** **Comments**

Pre-Measurement

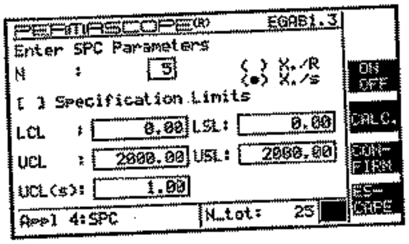




Measurements from a minimum of 5 subgroups are needed to calculate the control limits.

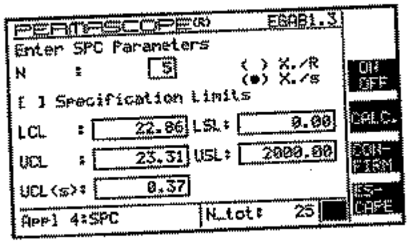
Calculate Control Limits

PARA-METER


PERMASCOPE® EGAB1.3
Enter SPC Parameters
N : 5 ( ) X./R (●) X./s
[ ] Specification Limits
LCL : 0.00 LSL: 0.00
UCL : 2000.00 USL: 2000.00
UCL(s): 1.00
Appl 4:SPC N_tot: 25

If you want the MMS® to calculate new control limits push the **PARA-METER** soft-key.

CALC.

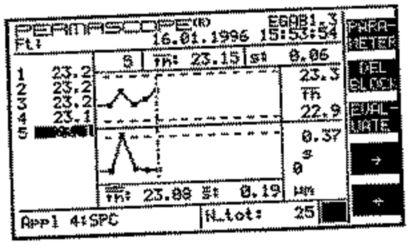

PERMASCOPE® EGAB1.3
Enter SPC Parameters
N : 5 ( ) X./R (●) X./s
[ ] Specification Limits
LCL : 22.86 LSL: 0.00
UCL : 23.31 USL: 2000.00
UCL(s): 0.37
Appl 4:SPC N_tot: 25

Press the softkey **CALC.** and the MMS® will calculate the control limits from the previous measurement series.

The limits will be displayed in the menu.

☞ If so desired, changes to the SPC parameters can still be entered.

CON-FIRM



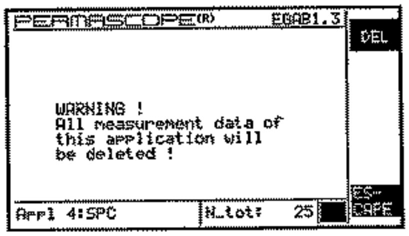
Save the control limits to the application.
You are now ready to start actual process control.

Key Sequence **Display** **Comments**

Delete the pre-measurement readings:

Delete Pre-Measurement Readings

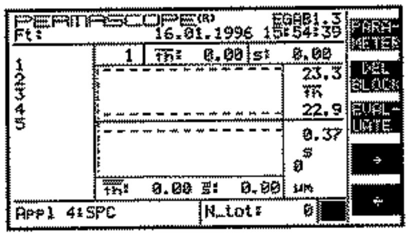
▼2 MENU



```
WARNING !
All measurement data of
this application will
be deleted !
```

Calls menu function 2 "Delete Appl. Measurement Data".

DEL



The pre-measurement readings will be deleted and the instrument is ready to start the control measurements for process control.

☞ We recommend to make reference measurements prior to actual measurements to prevent measurement errors.
For greater details see Chapter 6.

Example 7 PERMASCOPE®

Difference Measurement

Application: • Measurement of up to 4 paint coating layers on sheet metal.

A **new Application will be created** for the measurement application mentioned above. For this example, no other parameters need to be entered. **Normalization** is carried out directly **on the substrate material** (uncoated piece of sheet metal).

For a description of the Difference Measurement mode see Chapter 5, Section "Difference Measurement".

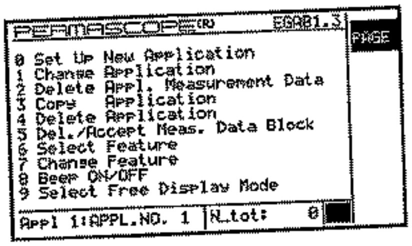
For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys see Chapter 6.

Preparation:
- A model EGAB1.3 magnetic induction probe is suitable for this measurement application.
- Connect the probe to the MMS®.
- Switch the MMS® on, ON key.

Setting-Up an Application / Probe Selection

Key Sequence	Display	Comments

MENU

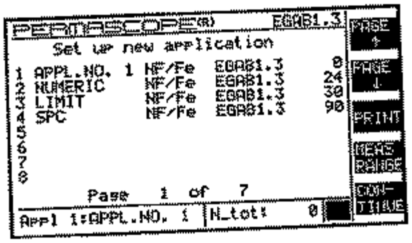


```
PERMASCOPE(R)              EGAB1.3
0 Set Up New Application
1 Change Application
2 Delete Appl. Measurement Data
3 Copy   Application
4 Delete Application
5 Del./Accept Meas. Data Block
6 Select Feature
7 Change Feature
8 Beep ON/OFF
9 Select Free Display Mode
Appl 1:APPL.NO. 1  |N_tot:      0
```

Calls the menu function screen.

A list of all menu functions is displayed covering several pages.

0 ENTER

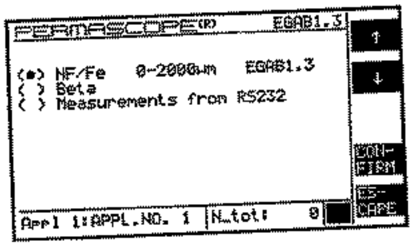


```
PERMASCOPE(R)              EGAB1.3
    Set up new application
1 APPL.NO. 1 NF/Fe  EGAB1.3      0
2 NUMERIC    NF/Fe  EGAB1.3     24
3 LIMIT      NF/Fe  EGAB1.3     30
4 SPC        NF/Fe  EGAB1.3     90
5
6
7
8
         Page   1  of   7
Appl 1:APPL.NO. 1  |N_tot:      0
```

Enter the number 0 to open the menu "Set-Up New Applications".

A screen with page 1 of all created applications appears.

5 ENTER



```
PERMASCOPE(R)              EGAB1.3

(•) NF/Fe   0-2000µm   EGAB1.3
( ) Beta
( ) Measurements from RS232

Appl 1:APPL.NO. 1  |N_tot:      0
```

Enter the number for the new application.

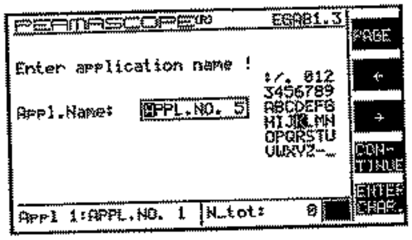
The instrument searches for connected probe models and displays them in a list.

☞ If the MMS® contains a BETASCOPE® MMS® plug-in testing module (602-267) Beta (for beta emitter) will always be displayed in the list.

Setting-Up an Application / Entering Names / Parameter Definition

Key Sequence | **Display** | **Comments**

CON-FIRM

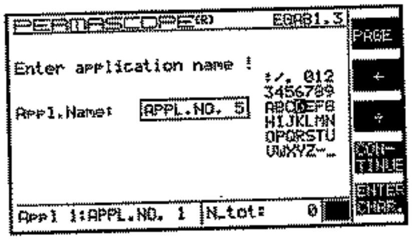


```
PERMASCOPE(R)                    EGAB1.3

Enter application name !
                              :/. 012
                              3456789
Appl.Name:    APPL.NO. 5      ABCDEFG
                              HIJKLMN
                              OPQRSTU
                              VWXYZ-_

Appl 1:APPL.NO. 1   |N_tot:       0
```

Select the probe model (NE/Fe ...).

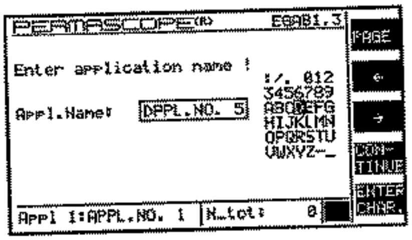
A screen to enter the name of the application will be displayed.

▼2, **◀4**, **6▶**, **▲8**, **ENTER CHAR.**



```
PERMASCOPE(R)                    EGAB1.3

Enter application name !
                              :/. 012
                              3456789
Appl.Name:    APPL.NO. 5      ABCDEFG
                              HIJKLMN
                              OPQRSTU
                              VWXYZ-_

Appl 1:APPL.NO. 1   |N_tot:       0
```

In our example DIFF MEAS.
Use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR..

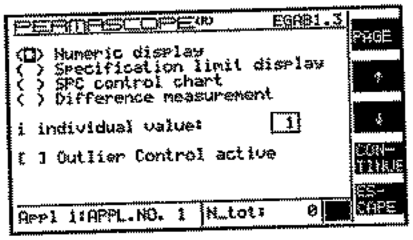


```
PERMASCOPE(R)                    EGAB1.3

Enter application name !
                              :/. 012
                              3456789
Appl.Name:    DPPL.NO. 5      ABCDEFG
                              HIJKLMN
                              OPQRSTU
                              VWXYZ-_

Appl 1:APPL.NO. 1   |N_tot:       0
```

☞ Use the DEL key to delete erroneous entries or unnecessary characters.

🗐 On how to enter names see also Chapter 6, page 6-24.

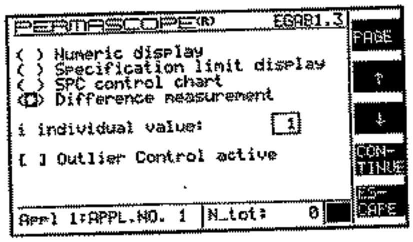
PAGE



```
PERMASCOPE(R)                    EGAB1.3
(■) Numeric display
( ) Specification limit display
( ) SPC control chart
( ) Difference measurement

i individual value:          1

[ ] Outlier Control active

Appl 1:APPL.NO. 1   |N_tot:       0
```

Open the next menu page to make additional selections.

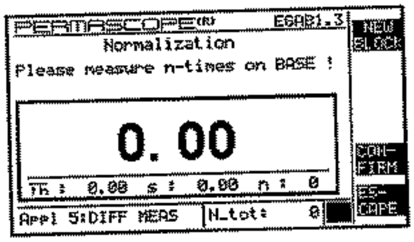
↓ **↓** **↓**



```
PERMASCOPE(R)                    EGAB1.3
( ) Numeric display
( ) Specification limit display
( ) SPC control chart
(■) Difference measurement

i individual value:          1

[ ] Outlier Control active

Appl 1:APPL.NO. 1   |N_tot:       0
```

Select "Difference measurement".

CON-TINUE



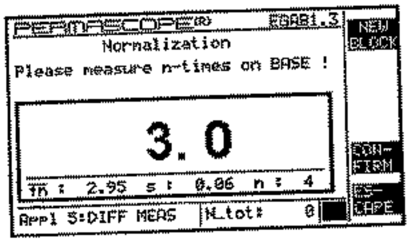
```
PERMASCOPE(R)                    EGAB1.3
             Normalization
Please measure n-times on BASE !

               0.00
 x̄ :   0.00   s :   0.00   n :   0
Appl 5:DIFF MEAS    |N_tot:       0
```

Finish parameter definition and change to the normalization function.

Normalization

Key Sequence | **Display** | **Comments**

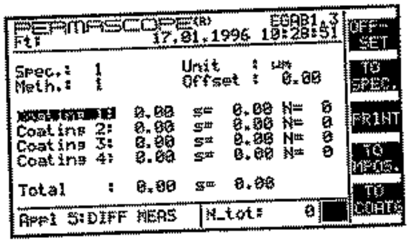
Measure n times on the uncoated specimen (sheet metal).



```
PERMASCOPE(R)                    EGAB1.3
             Normalization
Please measure n-times on BASE !

                 3.0
 īn :  2.95   s :  0.06   n :  4
Appl 5:DIFF MEAS       N_tot:          0
```

Repeat the measurement until the reading changes only slightly or not at all.

CON-FIRM



```
PERMASCOPE(R)                    EGAB1.3
Ft:               17.01.1996 10:28:51

Spec.:   1             Unit    :  µm
Meth.:   1             Offset  :  0.00

[illegible]      0.00   s=   0.00  N=   0
Coating 2:       0.00   s=   0.00  N=   0
Coating 3:       0.00   s=   0.00  N=   0
Coating 4:       0.00   s=   0.00  N=   0

Total       :    0.00   s=   0.00
Appl 5:DIFF MEAS       N_tot:          0
```

Save the application, change to the measurement mode of the newly created Application Number 5, DIFF MEAS.

☞ We recommend to make reference measurements prior to the actual measurements to prevent measurement errors.
For greater details see Chapter 6.

Example 8 SIGMA (DUPLEX)

Measurement of zinc and paint coatings (duplex coatings) on metal stampings (e.g., automotive parts). Expected coating thicknesses: Paint approx. 100 µm (4 mils), Zn approx. 14 µm (0.56 mils).

Application:
- Specification limit monitoring (Display presentation, acoustical)
- Normalize measuring system for application

A **new Application will be created** for the measuring application mentioned above. Parameters must be entered according to the above measurement application. **Normalization** is carried out **on** the **substrate** (uncoated piece of iron) **and** on **zinc** (saturation).

For a description of the measurement presentation mode "Specification Limit Display", see Chapter 5, Section "Specification Limit Display".

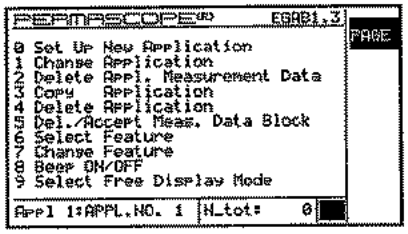
For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys see Chapter 6.

Preparation:
- A model ESG2 probe is suitable for this measurement application.
- Connect the probe to the MMS®.
- Switch the MMS® on, **ON** key.

Key Sequence **Display** **Comments**

Setting-Up an Application

MENU

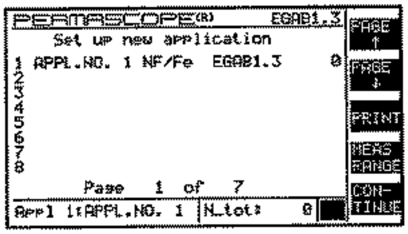


```
PERMASCOPE(R)                EGAB1.3
0 Set Up New Application
1 Change Application
2 Delete Appl. Measurement Data
3 Copy   Application
4 Delete Application
5 Del./Accept Meas. Data Block
6 Select Feature
7 Change Feature
8 Beep ON/OFF
9 Select Free Display Mode
Appl 1:APPL.NO. 1    N_tot:       0
```

Calls the menu function screen.

A list of all menu functions is displayed covering several pages.

0 **ENTER**



```
PERMASCOPE(R)                EGAB1.3
       Set up new application
1 APPL.NO. 1 NF/Fe  EGAB1.3        0
2
3
4
5
6
7
8
          Page   1  of   7
Appl 1:APPL.NO. 1    N_tot:       0
```

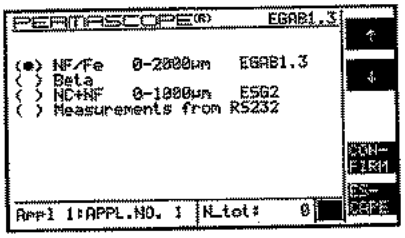
Enter the number 0 to open the menu "Set-Up New Applications".

A screen with page 1 of all created applications appears.

Setting-Up an Application / Probe Selection / Entering Names / Parameter Definition

Key Sequence **Display** **Comments**

▼2 ENTER



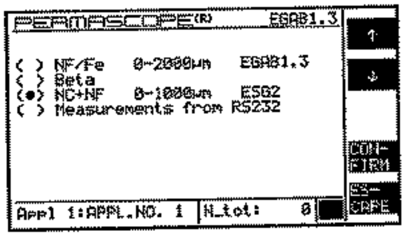
```
(●) NF/Fe    0-2000µm   EGAB1.3
( ) Beta
( ) NC+NF    0-1000µm   ESG2
( ) Measurements from RS232

Appl 1:APPL.NO. 1 |N_tot:     0
```

Enter the number for the new application.

The instrument searches for connected probe models and displays them in a list.

☞ If the MMS® contains a BETASCOPE® MMS® plug-in testing module (602-267) Beta (for beta emitter) will always be displayed in the list.

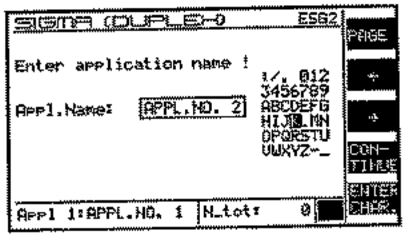
↓ ↓ ↓



```
( ) NF/Fe    0-2000µm   EGAB1.3
( ) Beta
(●) NC+NF    0-1000µm   ESG2
( ) Measurements from RS232

Appl 1:APPL.NO. 1 |N_tot:     0
```

Select the probe model (NC+NF ... ESG2)

CON-FIRM



```
Enter application name !
                            :/. 012
                            3456789
Appl.Name:   APPL.NO. 2     ABCDEFG
                            HIJKLMN
                            OPQRSTU
                            VWXYZ-_

Appl 1:APPL.NO. 1 |N_tot:     0
```

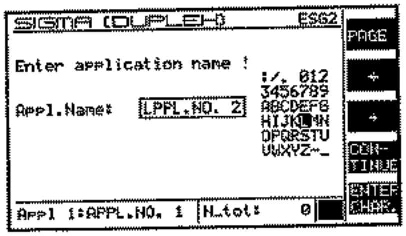
Determine the connected probe model (must be ESG2).

A screen to enter the name of the application will be displayed.

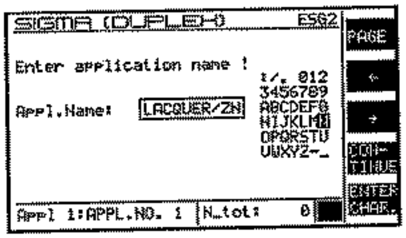
▼2 ◀4

6▶ ▲8

ENTER CHAR.



```
Enter application name !
                            :/. 012
                            3456789
Appl.Name:   LPPL.NO. 2     ABCDEFG
                            HIJKLMN
                            OPQRSTU
                            VWXYZ-_

Appl 1:APPL.NO. 1 |N_tot:     0
```



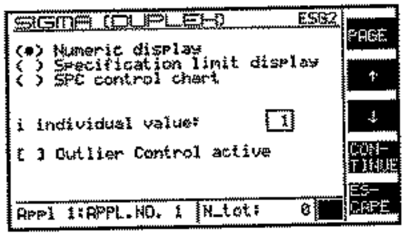
```
Enter application name !
                            :/. 012
                            3456789
Appl.Name:   LACQUER/ZN     ABCDEFG
                            HIJKLMN
                            OPQRSTU
                            VWXYZ-_

Appl 1:APPL.NO. 1 |N_tot:     0
```

In our example : LACQUER/ZN. Use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR.

☞ Use the DEL key to delete erroneous entries or unnecessary characters.

On how to enter names see also Chapter 6, page 6-24.

PAGE



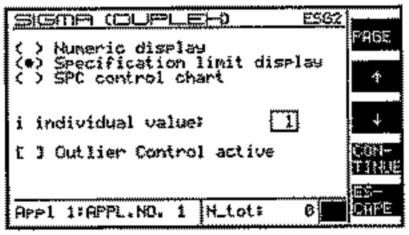
```
(●) Numeric display
( ) Specification limit display
( ) SPC control chart

i individual value:          1

[ ] Outlier Control active

Appl 1:APPL.NO. 1 |N_tot:     0
```

Open the next page to make additional selections.

Setting-Up an Application / Parameter Definition

Key Sequence | **Display** | **Comments**

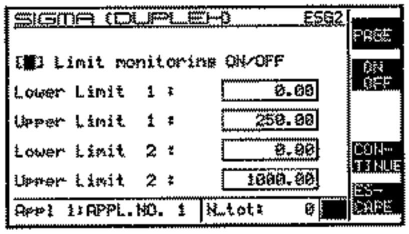
↓



```
SIGMA (DUPLEX)                      ESG2
( ) Numeric display
(●) Specification limit display
( ) SPC control chart

i individual value:          [ 1]

[ ] Outlier Control active

Appl 1:APPL.NO. 1  |N_tot:          0
```

Select the measurement display mode "Specification limit display".

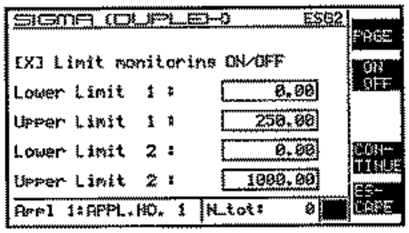
PAGE



```
SIGMA (DUPLEX)                      ESG2
[■] Limit monitoring ON/OFF
Lower Limit  1 :          [    0.00]
Upper Limit  1 :          [  250.00]
Lower Limit  2 :          [    0.00]
Upper Limit  2 :          [ 1000.00]
Appl 1:APPL.NO. 1  |N_tot:          0
```

Open the next page to make additional selections.

ON OFF

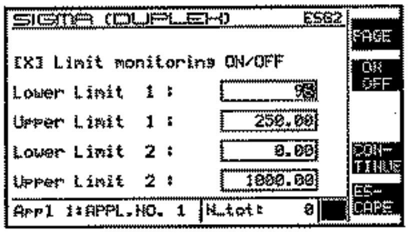


```
SIGMA (DUPLEX)                      ESG2
[X] Limit monitoring ON/OFF
Lower Limit  1 :          [    0.00]
Upper Limit  1 :          [  250.00]
Lower Limit  2 :          [    0.00]
Upper Limit  2 :          [ 1000.00]
Appl 1:APPL.NO. 1  |N_tot:          0
```

Activate specification limit monitoring (audible signal for upper and lower limit violations).

ENTER **9**

6▶



```
SIGMA (DUPLEX)                      ESG2
[X] Limit monitoring ON/OFF
Lower Limit  1 :          [      96]
Upper Limit  1 :          [  250.00]
Lower Limit  2 :          [    0.00]
Upper Limit  2 :          [ 1000.00]
Appl 1:APPL.NO. 1  |N_tot:          0
```

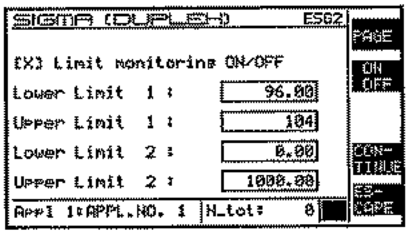
Enter the lower specification limit (96 µm/3.8 mils) of coating 1.

☞ Coating 1 = Paint coating

☞ Use **DEL** key to delete erroneous entries.

ENTER **1**

0 **◀4**



```
SIGMA (DUPLEX)                      ESG2
[X] Limit monitoring ON/OFF
Lower Limit  1 :          [   96.00]
Upper Limit  1 :          [     104]
Lower Limit  2 :          [    0.00]
Upper Limit  2 :          [ 1000.00]
Appl 1:APPL.NO. 1  |N_tot:          0
```

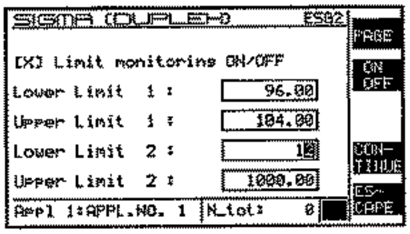
Enter the upper specification limit (104 µm/4.2 mils) of coating 1.

☞ Coating 1 = Paint coating

☞ Use **DEL** key to delete erroneous entries.

ENTER **1**

▼2



```
SIGMA (DUPLEX)                      ESG2
[X] Limit monitoring ON/OFF
Lower Limit  1 :          [   96.00]
Upper Limit  1 :          [  104.00]
Lower Limit  2 :          [      12]
Upper Limit  2 :          [ 1000.00]
Appl 1:APPL.NO. 1  |N_tot:          0
```

Enter the lower specification limit (12 µm/0.5 mils) of coating 2.

☞ Coating 2 = Zinc coating

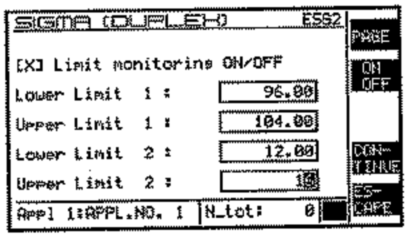
☞ Use **DEL** key to delete erroneous entries.

Key Sequence **Display** **Comments**

Parameter Def.

ENTER 1

6▶



```
SIGMA (DUPLEX)                ESG2   PAGE
[X] Limit monitoring ON/OFF          ON
Lower Limit  1 :          96.00      OFF
Upper Limit  1 :         104.00
Lower Limit  2 :          12.00      CON-
Upper Limit  2 :             16      TINUE
Appl 1:APPL.NO. 1  |N_tot:     0     ES-
                                     CAPE
```

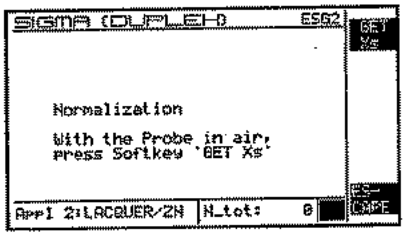
Enter the upper specification limit (16 µm/0.64 mils) of coating 2.

☞ Coating 2 = Zinc coating

☞ Use DEL key to delete erroneous entries.

Setting-Up an Application / Normalization

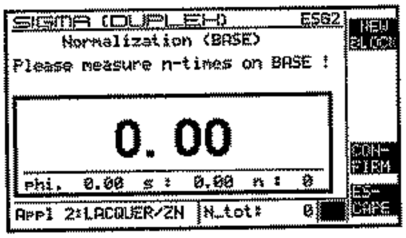
CON-TINUE



```
SIGMA (DUPLEX)                ESG2   GET
                                     Xs
Normalization
With the Probe in air,
press Softkey 'GET Xs'
                                     ES-
Appl 2:LACQUER/ZN  |N_tot:     0     CAPE
```

Finish parameter definition and change to the normalization function.

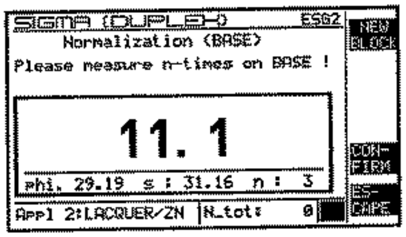
Place probe in air and press softkey GET Xs.



```
SIGMA (DUPLEX)                ESG2   NEW
      Normalization (BASE)           BLOCK
Please measure n-times on BASE !

            0.00                     CON-
                                     FIRM
phi.  0.00   s :  0.00   n :  0      ES-
Appl 2:LACQUER/ZN  |N_tot:     0     CAPE
```

Accept the air countrate (probe in air).

Measure n times on the substrate (steel piece without coatings to be measured).

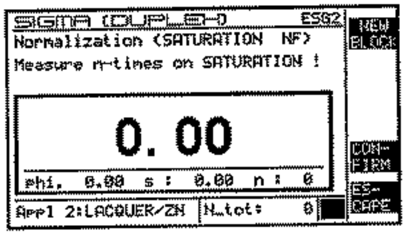


```
SIGMA (DUPLEX)                ESG2   NEW
      Normalization (BASE)           BLOCK
Please measure n-times on BASE !

            11.1                     CON-
                                     FIRM
phi. 29.19   s : 31.16   n :  3      ES-
Appl 2:LACQUER/ZN  |N_tot:     0     CAPE
```

Repeat the measurement until the reading changes only slightly or not at all.

☞ Lift the probe approx. 2 inches (5 cm) off the specimen before making the next measurement.

CON-FIRM

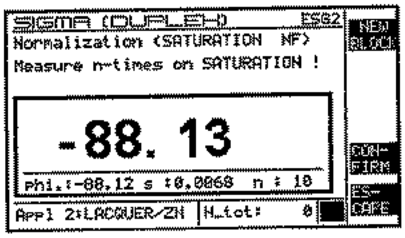


```
SIGMA (DUPLEX)                ESG2   NEW
Normalization (SATURATION  NF)       BLOCK
Measure n-times on SATURATION !

            0.00                     CON-
                                     FIRM
phi.  0.00   s :  0.00   n :  0      ES-
Appl 2:LACQUER/ZN  |N_tot:     0     CAPE
```

Accept the Base readings. You will be prompted for the saturation coating material measurement (= material of coating 2, in this example, Zinc).

☞ The saturation standard (∞) for Zn is included as a standard accessory.

Measure n times on the Zn-saturation standard.

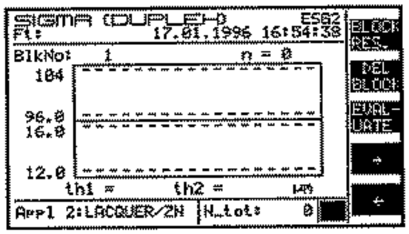
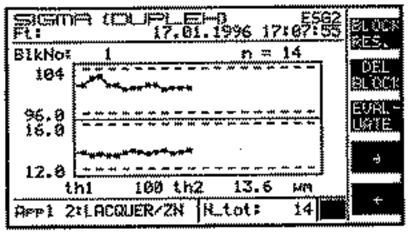


```
SIGMA (DUPLEX)                ESG2   NEW
Normalization (SATURATION  NF)       BLOCK
Measure n-times on SATURATION !

          -88.13                     CON-
                                     FIRM
phi.:-88.12 s :0.0068  n : 10        ES-
Appl 2:LACQUER/ZN  |N_tot:     0     CAPE
```

Repeat the measurement until the Phi reading changes only slightly or not at all.

☞ Lift the probe approx. 2 inches (5 cm) off the specimen before making the next measurement.

Measurement

Key Sequence	Display	Comments
CON-FIRM		Accept the saturation readings. Finish the normalization function and change to the measurement mode of the new application number 2, LACQUER/ZN.
		You are now ready to start the measurement process.

☞ We recommend to make a reference measurement to verify normalization.

Example 9 SIGMA (NF/Fe)

Measurement of a zinc coating on steel.

Application:
- Numeric Display
- 5 measurements will be averaged and grouped to a 'single measurement value'.
- Normalize measuring system for application

A **new Application will be created** for the measuring application mentioned above. According to the above measurement application, only the parameter "i single readings" of menu function 0, Create Application, needs to be entered. **Normalization** is carried out **on** the **substrate** (uncoated piece of iron) **and** on **zinc** (saturation).

For a description of the measurement presentation mode Numeric Display, see Chapter 5, Section "Numeric Display".

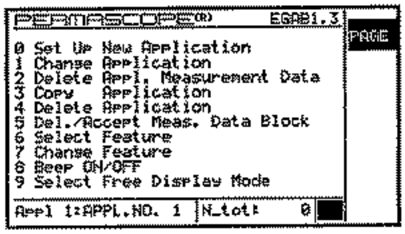
For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys see Chapter 6.

Preparation:
- A model ESD1 probe is suitable for this measurement application.
- Connect the probe to the MMS®.
- Switch the MMS® ON ON.

Key Sequence **Display** **Comments**

Setting-Up an Application / Probe Selection

MENU

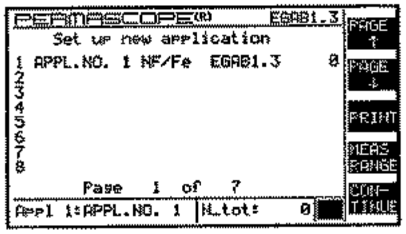


```
PERMASCOPE(R)              EGAB1.3
0 Set Up New Application
1 Change Application
2 Delete Appl. Measurement Data
3 Copy   Application
4 Delete Application
5 Del./Accept Meas. Data Block
6 Select Feature
7 Change Feature
6 Beep ON/OFF
9 Select Free Display Mode
Appl 1:APPL.NO. 1 |N_tot:        0
```

Calls the menu function screen.

A list of all menu functions is displayed covering several pages.

0 ENTER

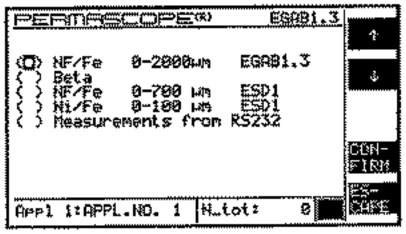


```
PERMASCOPE(R)              EGAB1.3
   Set up new application
1 APPL.NO. 1 NF/Fe  EGAB1.3      0
2
3
4
5
6
7
8
      Page   1  of   7
Appl 1:APPL.NO. 1 |N_tot:        0
```

Enter the number 0 to open the menu "Set-Up New Applications".

A screen with page 1 of all created applications appears.

▼2 ENTER



```
PERMASCOPE(R)              EGAB1.3

(□) NF/Fe    0-2000µm   EGAB1.3
( ) Beta
( ) NF/Fe    0-700 µm   ESD1
( ) Ni/Fe    0-100 µm   ESD1
( ) Measurements from RS232

Appl 1:APPL.NO. 1 |N_tot:        0
```

Enter the number for the new application.

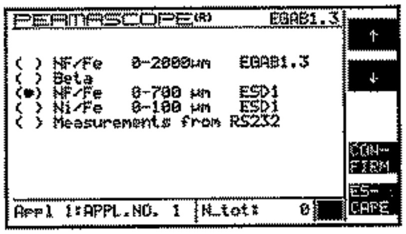
The instrument searches for connected probe models and displays them in a list.

Setting-Up an Application / Probe Selection / Entering Names / Parameter Definition

Key Sequence | **Display** | **Comments**

☞ If the MMS® contains a BETA-SCOPE® MMS® plug-in testing module (602-267) Beta (for beta emitter) will always be displayed in the list. Probes listed here serve only as examples. The actual list depends on the instrument combination and the connected probes.

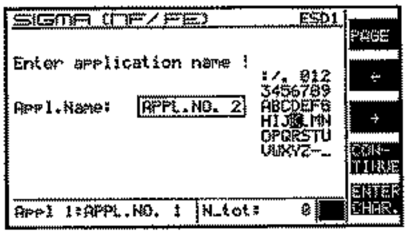
↓ ↓ ↓



```
PERMASCOPE(R)                EGAB1.3

( ) NF/Fe   0-2000µm   EGAB1.3
( ) Beta
(●) NF/Fe   0-700 µm   ESD1
( ) Ni/Fe   0-100 µm   ESD1
( ) Measurements from RS232

Appl 1:APPL.NO. 1  |N_tot:     0
```

Select the probe model (NF/FE ... 0-1111, ESD1).

CON-FIRM



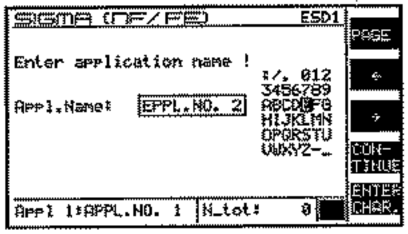
```
SIGMA (NF/FE)                  ESD1

Enter application name !
                             :/. 012
                             3456789
Appl.Name:    APPL.NO. 2     ABCDEFG
                             HIJKLMN
                             OPQRSTU
                             VWXYZ-_

Appl 1:APPL.NO. 1  |N_tot:     0
```

Determine the connected probe model (must be ESD1).

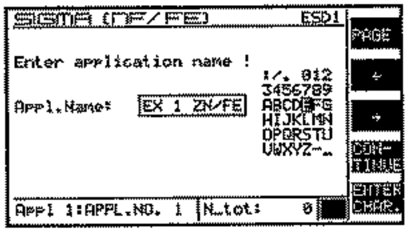
A screen to enter the name of the application will be displayed.

▼2 ◀4 6▶ ▲8

ENTER CHAR.



```
SIGMA (NF/FE)                  ESD1

Enter application name !
                             :/. 012
                             3456789
Appl.Name:    EPPL.NO. 2     ABCDEFG
                             HIJKLMN
                             OPQRSTU
                             VWXYZ-_

Appl 1:APPL.NO. 1  |N_tot:     0
```



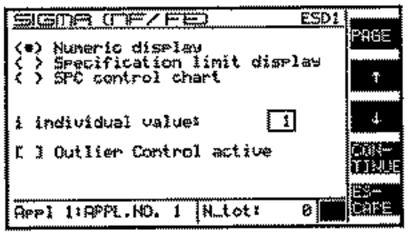
```
SIGMA (NF/FE)                  ESD1

Enter application name !
                             :/. 012
                             3456789
Appl.Name:    EX 1 ZN/FE     ABCDEFG
                             HIJKLMN
                             OPQRSTU
                             VWXYZ-_

Appl 1:APPL.NO. 1  |N_tot:     0
```

In our example : EX1 ZN/FE. Use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR..

☞ Use the DEL key to delete erroneous entries or unnecessary characters.

On how to enter names see also Chapter 6, page 6-24.

PAGE



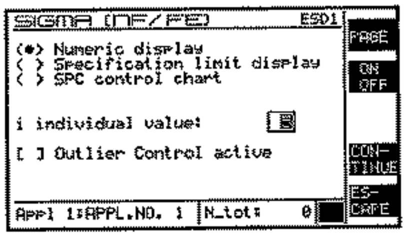
```
SIGMA (NF/FE)                  ESD1
(●) Numeric display
( ) Specification limit display
( ) SPC control chart

i individual values:       [1]

[ ] Outlier Control active

Appl 1:APPL.NO. 1  |N_tot:     0
```

Open the next page to make additional selections.

Key Sequence **Display** **Comments**

Parameter Definition

ENTER **5**



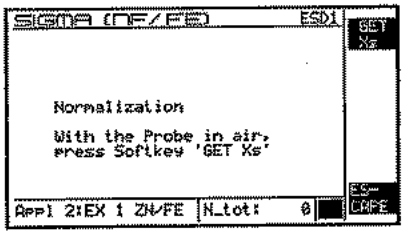
```
SIGMA (NF/FE)                    ESD1   PAGE
(●) Numeric display                     ON
( ) Specification limit display         OFF
( ) SPC control chart

i individual value:           5

[ ] Outlier Control active              CON-
                                        TINUE
                                        ES-
Appl 1:APPL.NO. 1  |N_tot:        0     CAPE
```

Highlight the parameter "i individual value" and enter the number of the desired readings.

5 measurements will be averaged and grouped to a single measurement value.

Setting-Up an Application / Normalization

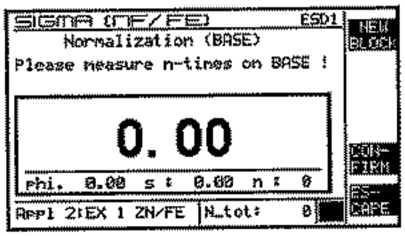
CON-TINUE



```
SIGMA (NF/FE)                    ESD1   GET
                                        Xs


      Normalization

      With the Probe in air,
      press Softkey 'GET Xs'
                                        ES-
Appl 2:EX 1 ZN/FE  |N_tot:        0     CAPE
```

No additional parameter selections, change to the normalization function.

Place probe in air and press softkey **GET Xs**.

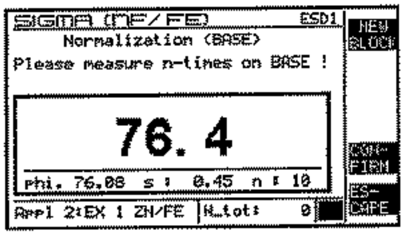


```
SIGMA (NF/FE)                    ESD1   NEW
      Normalization (BASE)              BLOCK
Please measure n-times on BASE !

              0.00
                                        CON-
 Phi.   0.00   s :   0.00   n :  0      FIRM
                                        ES-
Appl 2:EX 1 ZN/FE  |N_tot:        0     CAPE
```

Accept the air countrate.

You will be prompted to measure on Base (Fe).

Measure n times on the substrate (iron piece without coatings to be measured).

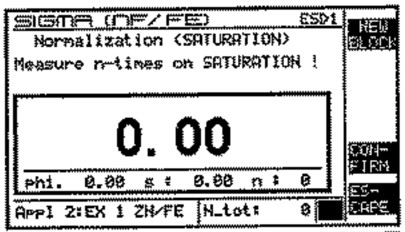


```
SIGMA (NF/FE)                    ESD1   NEW
      Normalization (BASE)              BLOCK
Please measure n-times on BASE !

              76.4
                                        CON-
 Phi. 76.08   s :   0.45   n : 10       FIRM
                                        ES-
Appl 2:EX 1 ZN/FE  |N_tot:        0     CAPE
```

Repeat the measurement until the Phi reading changes only slightly or not at all.

☞ Lift the probe approx. 2 inches (5 cm) off the specimen before making the next measurement.

CON-FIRM

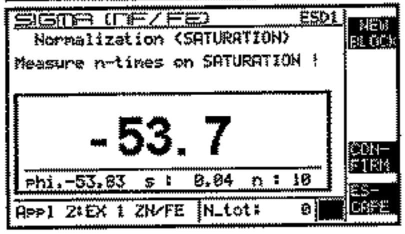


```
SIGMA (NF/FE)                    ESD1   NEW
   Normalization (SATURATION)           BLOCK
Measure n-times on SATURATION !

              0.00
                                        CON-
 Phi.   0.00   s :   0.00   n :  0      FIRM
                                        ES-
Appl 2:EX 1 ZN/FE  |N_tot:        0     CAPE
```

Accept the Base readings. You will be prompted for the saturation measurement (= coating material).

☞ The saturation standard for Zn is included as a standard accessory.

Measure n times on the Zn saturation standard.



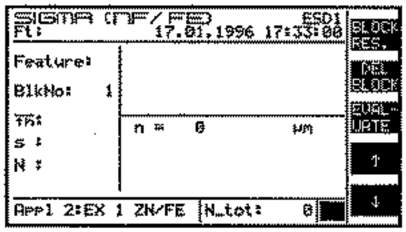
```
SIGMA (NF/FE)                    ESD1   NEW
   Normalization (SATURATION)           BLOCK
Measure n-times on SATURATION !

             -53.7
                                        CON-
 Phi.-53.83   s :   0.04   n : 10       FIRM
                                        ES-
Appl 2:EX 1 ZN/FE  |N_tot:        0     CAPE
```

Repeat the measurement until the Phi reading changes only slightly or not at all.

☞ Lift the probe approx. 2 inches (5 cm) off the specimen before making the next measurement.

Save New Appl.

Key Sequence	Display	Comments
CON-FIRM	see below	Save the new application with its parameters and normalization. Change to the measuring mode of the newly created application number 2, EX2 ZN/FE.



SIGMA (NF/FE) ESD1
Ft: 17.01.1996 17:33:00
Feature:
BlkNo: 1
TG:
s :
N :
n = 0 µm
Appl 2:EX 1 ZN/FE
N_tot: 0

☞ We recommend to make reference measurements prior to the actual measurements to prevent measurement errors. See also Chapter 6.

Example 10 NICKELSCOPE®

Measurement of a nickel coating on copper. Expected coating thickness approx. 75 µm (3 mils).

Application:
- Monitor Specification Limits
- 3 measurements per block
- Combine 10 blocks for an evaluation with automatic printout
- Normalize measuring system for application

A **new application will be created** for the measurement application of example 10. The respective **parameters need to be set. Normalization** is carried out **on** an **Ni saturation standard** (Ni Sat., included with the probe shipment as standard accessory).

For a description of the measurement presentation mode "Numeric Display", see Chapter 5, Section "Numeric Display".

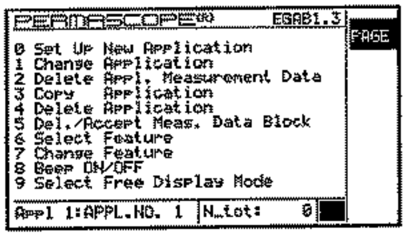
For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys see Chapter 6.

Preparation:
- A model EN3 probe is suited for the measurement of nickel coatings on copper.
- Connect the probe to the MMS®.
- Switch the MMS® on, ON key.

Key Sequence | **Display** | **Comments**

Setting-Up an Application

MENU

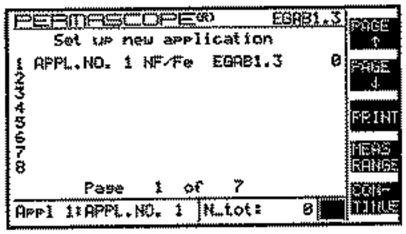


```
PERMASCOPE®              EGAB1.3
0 Set Up New Application
1 Change Application
2 Delete Appl. Measurement Data
3 Copy   Application
4 Delete Application
5 Del./Accept Meas. Data Block
6 Select Feature
7 Change Feature
8 Beep ON/OFF
9 Select Free Display Mode
Appl 1:APPL.NO. 1 |N_tot:     0
```

Calls the menu function screen.

A list with all menu functions is displayed covering several pages.

0 **ENTER**



```
PERMASCOPE®              EGAB1.3
    Set up new application
1 APPL.NO. 1 NF/Fe  EGAB1.3     0
2
3
4
5
6
7
8
        Page   1  of   7
Appl 1:APPL.NO. 1 |N_tot:     0
```

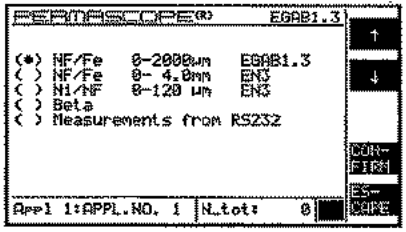
Enter the number 0 to open the menu function "Set Up New Application".

A screen with page 1 of all previously created applications appears.

Setting-Up an Application / Probe Selection / Entering Names

Key Sequence **Display** **Comments**

▼2 **ENTER**

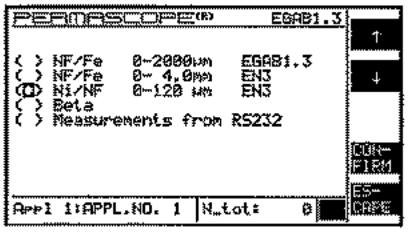

PERMASCOPE® EGAB1.3
(●) NF/Fe 0-2000µm EGAB1.3
( ) NF/Fe 0- 4.0mm EN3
( ) Ni/NF 0-120 µm EN3
( ) Beta
( ) Measurements from RS232
Appl 1:APPL.NO. 1 N_tot: 0

Enter the number for the new application.

The instrument searches for connected probe models and displays them in a list.

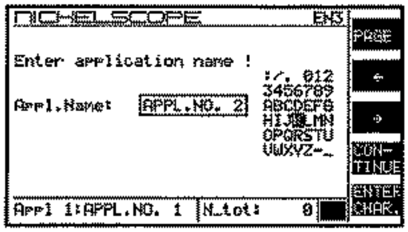
☞ If the MMS® contains a BETASCOPE® MMS® plug-in testing module (602-267) Beta (for beta emitter) will always be displayed in the list. Probes listed here serve only as examples. The actual list depends on the instrument combination and the connected probes.

↓ **↓**


PERMASCOPE® EGAB1.3
( ) NF/Fe 0-2000µm EGAB1.3
( ) NF/Fe 0- 4.0mm EN3
(●) Ni/NF 0-120 µm EN3
( ) Beta
( ) Measurements from RS232
Appl 1:APPL.NO. 1 N_tot: 0

Select the probe model (Ni/NF ... EN3).

CON-FIRM


NICKELSCOPE EN3
Enter application name !
Appl.Name: APPL.NO. 2
:/. 012 3456789 ABCDEFG HIJKLMN OPQRSTU VWXYZ-_
Appl 1:APPL.NO. 1 N_tot: 0

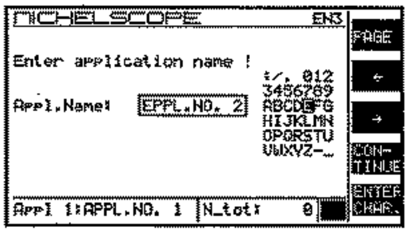
Determine the connected probe model (must be EN3).

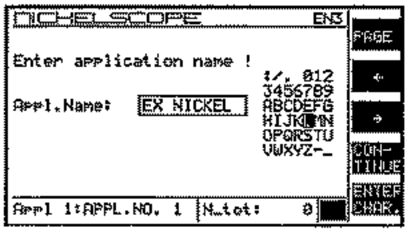
A screen to enter the name of the application will be displayed.

▼2 **◀4**

6▶ **▲8**

ENTER CHAR.


NICKELSCOPE EN3
Enter application name !
Appl.Name: EPPL.NO. 2
:/. 012 3456789 ABCDEFG HIJKLMN OPQRSTU VWXYZ-_
Appl 1:APPL.NO. 1 N_tot: 0


NICKELSCOPE EN3
Enter application name !
Appl.Name: EX NICKEL
:/. 012 3456789 ABCDEFG HIJKLMN OPQRSTU VWXYZ-_
Appl 1:APPL.NO. 1 N_tot: 0

In our example : EX NICKEL.
Use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR.

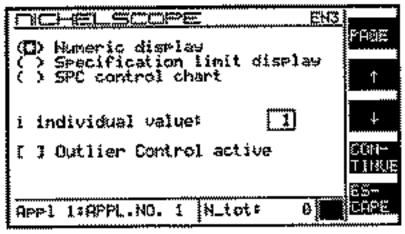
☞ Use the DEL key to delete erroneous entries or unnecessary characters.

☞ On how to enter names see also Chapter 6, page 6-24.

Setting-Up an Application / Parameter Definition

Key Sequence **Display** **Comments**

PAGE



(■) Numeric display
( ) Specification limit display
( ) SPC control chart

i individual value: 1

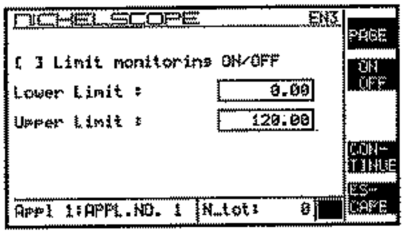
[ ] Outlier Control active

Appl 1:APPL.NO. 1 | N_tot: 0

Open the next menu page to make additional selections.

No parameter selections on this menu page.

PAGE



[ ] Limit monitoring ON/OFF

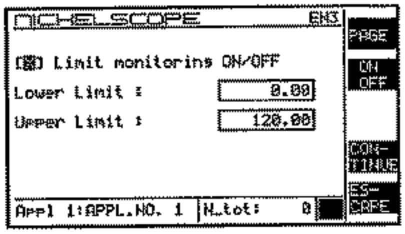
Lower Limit : 0.00

Upper Limit : 120.00

Appl 1:APPL.NO. 1 | N_tot: 0

Open the next menu page to make additional selections.

ON OFF



[■] Limit monitoring ON/OFF

Lower Limit : 0.00

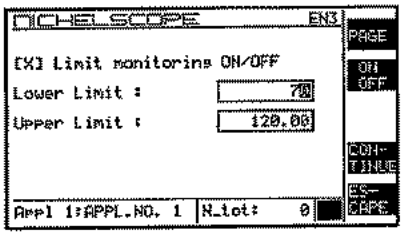
Upper Limit : 120.00

Appl 1:APPL.NO. 1 | N_tot: 0

Activate specification limit monitoring (audible signal for upper and lower limit violations).

ENTER **7**

0



[X] Limit monitoring ON/OFF

Lower Limit : 70

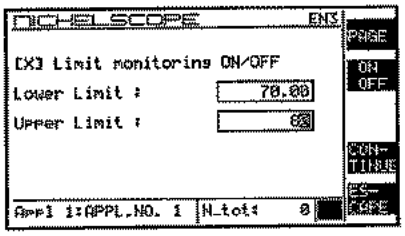
Upper Limit : 120.00

Appl 1:APPL.NO. 1 | N_tot: 0

Enter the lower specification limit (70 µm/2.8 mils).

ENTER **▲8**

0



[X] Limit monitoring ON/OFF

Lower Limit : 70.00

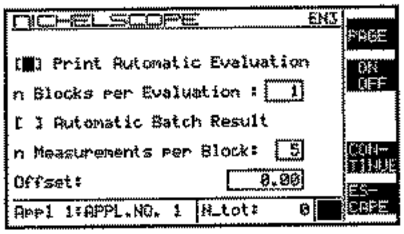
Upper Limit : 80

Appl 1:APPL.NO. 1 | N_tot: 0

Enter the upper specification limit (80 µm/3.2 mils).

☞ Use the **DEL** key to delete erroneous entries.

PAGE



[■] Print Automatic Evaluation

n Blocks per Evaluation : 1

[ ] Automatic Batch Result

n Measurements per Block: 5

Offset: 0.00

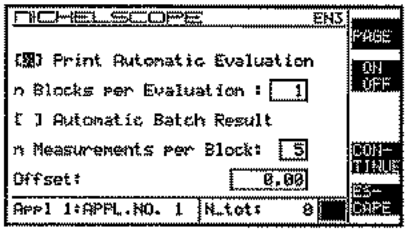
Appl 1:APPL.NO. 1 | N_tot: 0

Open the next menu page to make additional selections.

Key Sequence **Display** **Comments**

Setting-Up an Application / Parameter Definition

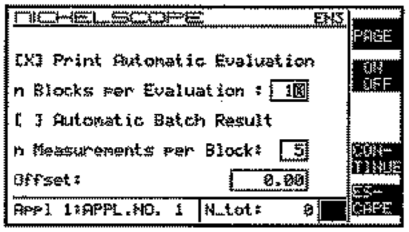
ON OFF



```
[X] Print Automatic Evaluation
n Blocks per Evaluation : 1
[ ] Automatic Batch Result
n Measurements per Block: 5
Offset: 0.00
Appl 1:APPL.NO. 1 |N_tot: 0
```

Activate automatic evaluation printing.

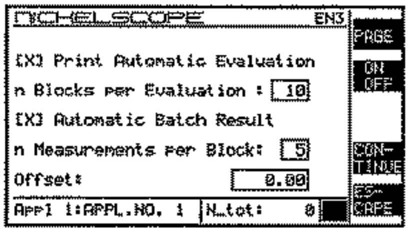
ENTER **1** **0**



```
[X] Print Automatic Evaluation
n Blocks per Evaluation : 10
[ ] Automatic Batch Result
n Measurements per Block: 5
Offset: 0.00
Appl 1:APPL.NO. 1 |N_tot: 0
```

Enter the number of blocks to be combined for an (automatic) evaluation printing (10).

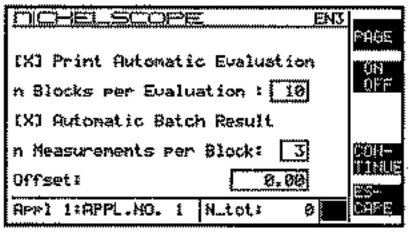
ENTER **ON OFF**



```
[X] Print Automatic Evaluation
n Blocks per Evaluation : 10
[X] Automatic Batch Result
n Measurements per Block: 5
Offset: 0.00
Appl 1:APPL.NO. 1 |N_tot: 0
```

Activate the automatic batch (block) result.

ENTER **3**



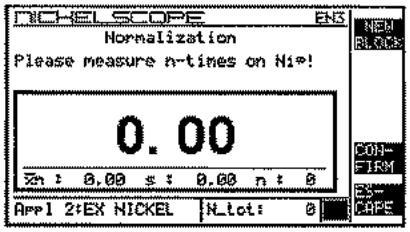
```
[X] Print Automatic Evaluation
n Blocks per Evaluation : 10
[X] Automatic Batch Result
n Measurements per Block: 3
Offset: 0.00
Appl 1:APPL.NO. 1 |N_tot: 0
```

Enter the number of measurements per block (3).

A group with batch (block) results is generated automatically after 3 measurements.

Normalization

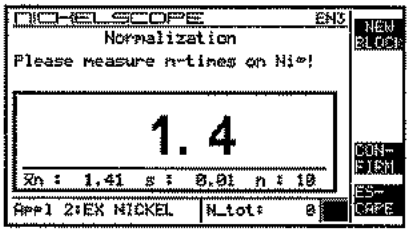
CON-TINUE



```
Normalization
Please measure n-times on Ni∞!
0. 00
X̄n : 0.00 s : 0.00 n : 0
Appl 2:EX NICKEL |N_tot: 0
```

Finish parameter definition and change to the normalization function.

Measure n times on the Ni saturation standard.



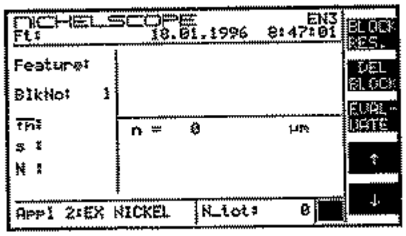
```
Normalization
Please measure n-times on Ni∞!
1. 4
X̄n : 1.41 s : 0.01 n : 10
Appl 2:EX NICKEL |N_tot: 0
```

Repeat the measurement until the X̄n reading changes only slightly or not at all.

Key Sequence **Display** **Comments**

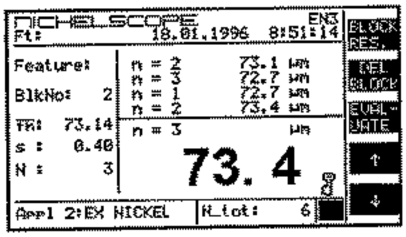
Measurement

CON-FIRM



NICHELSCOPE EN3
Ft: 18.01.1996 8:47:01
Feature:
BlkNo: 1
$\overline{TR}$:
s :
N :
n = 0 µm
Appl 2:EX NICKEL
N_tot: 0

Save the application, change to the measuring mode of the newly created application number 2, EX NICKEL.



NICHELSCOPE EN3
Ft: 18.01.1996 8:51:14
Feature:
BlkNo: 2
$\overline{TR}$: 73.14
s : 0.40
N : 3
n = 2 73.1 µm
n = 3 72.7 µm
n = 1 72.7 µm
n = 2 73.4 µm
n = 3 µm
73.4
Appl 2:EX NICKEL
N_tot: 6

You are now ready to start the measurement process.

☞ We recommend to make reference measurements prior to the actual measurements to prevent measurement errors.
📖 For greater details see Chapter 6.

Example 1 BETA

Measurement of the coating thickness of gold plated contacts (bronze substrate). Expected coating thickness: approx. 1 µm (40 µin).

Application:
- Specification limit monitoring (acoustic signal only)
- 5 measurements per block
- Combine 5 blocks for an evaluation with automatic printout
- Document block results without single readings
- Calibrate/normalize measuring system for application

A **new application will be created** for the example mentioned above. The respective parameters need to be set. **Calibration** is performed **using Au/Ni standards** followed by **normalization on the substrate bronze.**

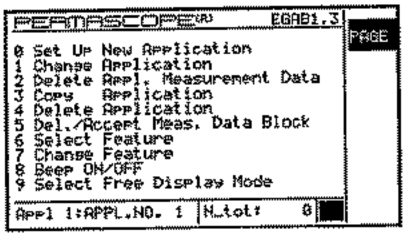
📄 For a description of the measurement presentation mode Numeric Display, see Chapter 5, Section "Numeric Display".

📄 For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys see Chapter 6.

Preparation:
- Find a suitable probe in Table 8_2 of Chapter 8, page 8-8: The Promethium Source PM-147 offers a suitable measurement range for a gold coating with an expected coating thickness of 1 µm (40 µin).
- Determine a suitable aperture platen (see Chapter 5, Section "Handling of a Probe" and Chapter 8, Section "Coating Thickness Measurement with the Beta Backscatter Method").
- Install the aperture platen and source in the measuring table (see Chapter 5, Section "Handling of a Probe). Measuring table used: Z14NG.
- Connect the measuring table to the MMS® (BETASCOPE® terminals).
- Switch the MMS® on, ON key.

The detector (GM-tube) installed in the measuring table will need at least 15 minutes warm-up time **prior to the measurement** for stable operation. Place the substrate material on the platen, switch the MMS® on, and wait a minimum of 15 minutes. Then the detector will have reached its operating temperature.

Setting-Up Appl.

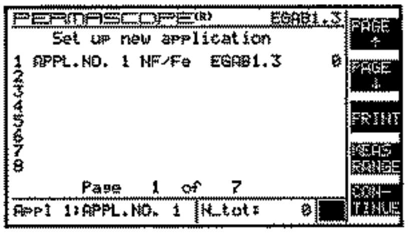
Key Sequence	Display	Comments
MENU		Calls the menu function screen. A list with all menu functions is displayed covering several pages.

```
PERMASCOPE®                  EGAB1.3
0 Set Up New Application
1 Change Application
2 Delete Appl. Measurement Data
3 Copy   Application
4 Delete Application
5 Del./Accept Meas. Data Block
6 Select Feature
7 Change Feature
8 Beep ON/OFF
9 Select Free Display Mode
Appl 1:APPL.NO. 1  |N_tot:        0
```

Setting-Up an Application / Probe Selection / Entering Names

Key Sequence | **Display** | **Comments**

0 ENTER

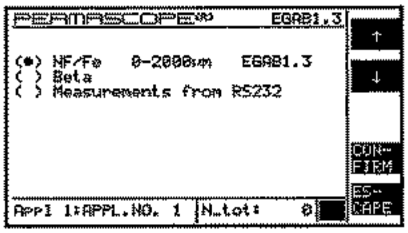


```
PERMASCOPE®                    EGAB1.3
    Set up new application
1 APPL.NO. 1 NF/Fe  EGAB1.3          0
2
3
4
5
6
7
8
          Page   1   of   7
Appl 1:APPL.NO. 1 |N_tot:            0
```

Enter the number 0 to open the menu function 'Set Up New Application'.

A screen with page 1 of all previously created applications appears.

▼2 ENTER



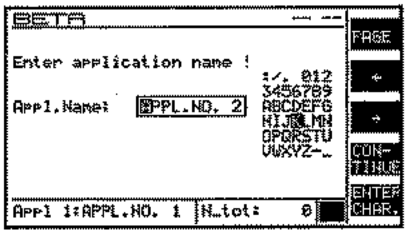
```
PERMASCOPE®                    EGAB1.3

(●) NF/Fe   0-2000µm    EGAB1.3
( ) Beta
( ) Measurements from RS232

Appl 1:APPL.NO. 1 |N_tot:            0
```

Enter the number for the new application.

The instrument searches for connected probe models and displays them in a list.

☞ In this example, a magnetic induction probe, model EGAB1.3, is connected to the instrument, in addition to the beta probe.

↓ CON- FIRM

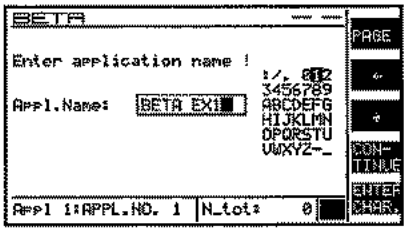


```
BETA                              -- --

Enter application name !
                                 :/, 012
                                 3456789
Appl.Name:    [APPL.NO. 2]       ABCDEFG
                                 HIJKLMN
                                 OPQRSTU
                                 VWXYZ-_

Appl 1:APPL.NO. 1 |N_tot:            0
```

Select the probe model (BETA).

A menu page to enter the name of the application will be displayed.

▼2 ◀4
6▶ ▲8
ENTER CHAR.



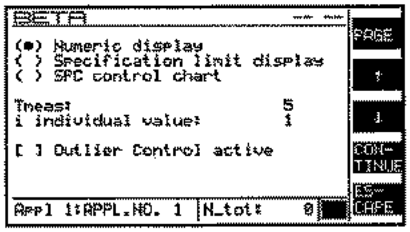
```
BETA                              -- --

Enter application name !
                                 :/, 012
                                 3456789
Appl.Name:    [BETA EX1█ ]       ABCDEFG
                                 HIJKLMN
                                 OPQRSTU
                                 VWXYZ-_

Appl 1:APPL.NO. 1 |N_tot:            0
```

Enter the name for the new application.
For our example: BETA EX1, use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR..

☞ Use the DEL key to delete erroneous entries or unnecessary characters.

☞ On how to enter names see also Chapter 6, page 6-34.

PAGE

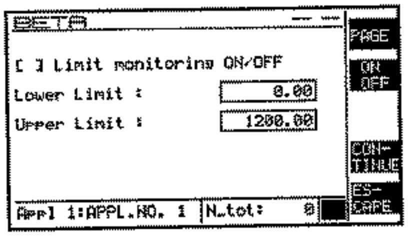
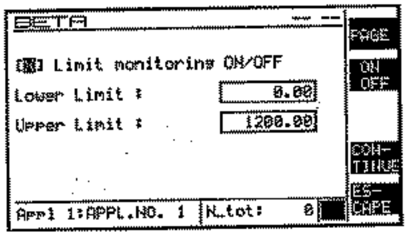
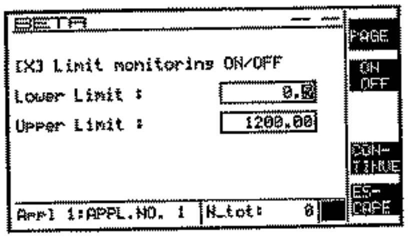
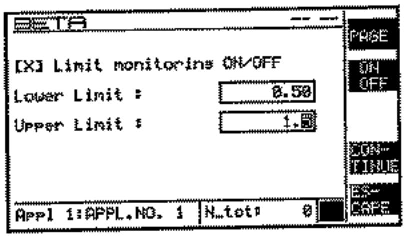
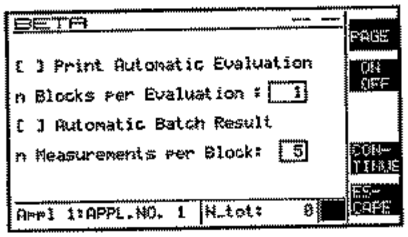
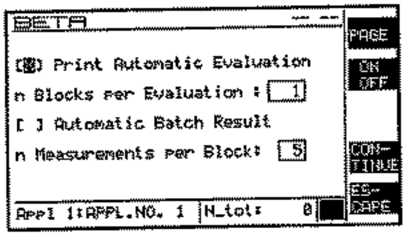


```
BETA                              -- --
(●) Numeric display
( ) Specification limit display
( ) SPC control chart

Tmeas:                          5
i individual value:             1

[ ] Outlier Control active

Appl 1:APPL.NO. 1 |N_tot:            0
```

Open the next menu page to make additional selections.

No selections are made on this menu page.

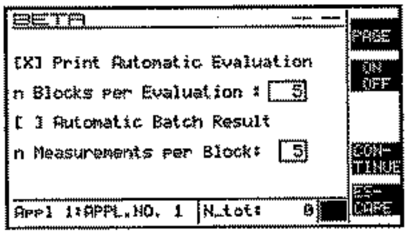
Setting-Up an Application / Defining Parameters

Key Sequence	Display	Comments
PAGE	 BETA [ ] Limit monitoring ON/OFF Lower Limit : 0.00 Upper Limit : 1200.00 Appl 1:APPL.NO. 1 | N_tot: 0	Open the next menu page to make additional selections.
ON OFF	 BETA [■] Limit monitoring ON/OFF Lower Limit : 0.00 Upper Limit : 1200.00 Appl 1:APPL.NO. 1 | N_tot: 0	Activate specification limit monitoring (audible signal for upper and lower limit violations).
ENTER 0 . 5	 BETA [X] Limit monitoring ON/OFF Lower Limit : 0.■ Upper Limit : 1200.00 Appl 1:APPL.NO. 1 | N_tot: 0	Enter the lower specification limit (0.5 µm, 20 µin). ☞ Use the DEL key to delete erroneous entries.
ENTER 1 . 5	 BETA [X] Limit monitoring ON/OFF Lower Limit : 0.50 Upper Limit : 1.■ Appl 1:APPL.NO. 1 | N_tot: 0	Enter the upper specification limit (1.5 µm, 60 µin). ☞ Use the DEL key to delete erroneous entries.
PAGE	 BETA [ ] Print Automatic Evaluation n Blocks per Evaluation : 1 [ ] Automatic Batch Result n Measurements per Block: 5 Appl 1:APPL.NO. 1 | N_tot: 0	Open the next menu page to make additional selections.
ON OFF	 BETA [■] Print Automatic Evaluation n Blocks per Evaluation : 1 [ ] Automatic Batch Result n Measurements per Block: 5 Appl 1:APPL.NO. 1 | N_tot: 0	Activate automatic evaluation printing.

Key Sequence | **Display** | **Comments**

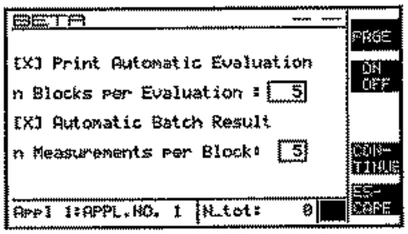
Setting-Up an Appl. /Def. Parameters

ENTER **5**


BETA
[X] Print Automatic Evaluation
n Blocks per Evaluation : 5
[ ] Automatic Batch Result
n Measurements per Block: 5
Appl 1:APPL.NO. 1 | N_tot: 0

Enter the number of blocks to be combined for an (automatic) evaluation printing (5).

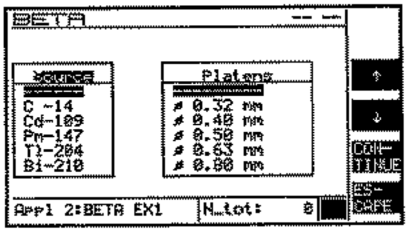
ENTER **ON OFF**


BETA
[X] Print Automatic Evaluation
n Blocks per Evaluation : 5
[X] Automatic Batch Result
n Measurements per Block: 5
Appl 1:APPL.NO. 1 | N_tot: 0

Activate the automatic batch (block) result.

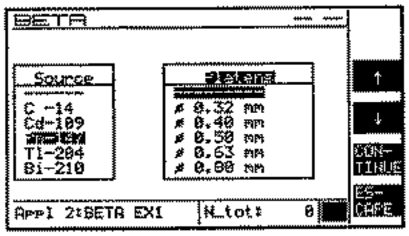
Setting-Up an Application / Select Source

CON-TINUE


BETA
Source: C -14, Cd-109, Pm-147, Tl-204, Bi-210
Platens: ø 0.32 mm, ø 0.40 mm, ø 0.50 mm, ø 0.63 mm, ø 0.80 mm
Appl 2:BETA EX1 | N_tot: 0

No additional parameter selections. Change to the specification menu for the source.

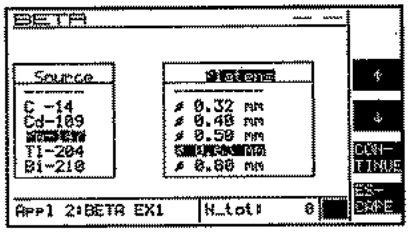
↓ **↓** **↓** **ENTER**


BETA
Source: C -14, Cd-109, Pm-147, Tl-204, Bi-210
Platens: ø 0.32 mm, ø 0.40 mm, ø 0.50 mm, ø 0.63 mm, ø 0.80 mm
Appl 2:BETA EX1 | N_tot: 0

Select the source in use.

☞ The source type is engraved on the packaging.

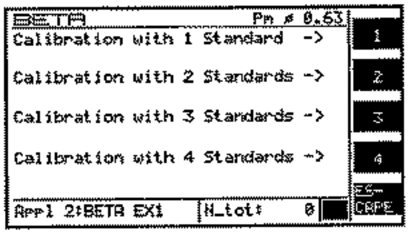
↓ **↓** **↓** **↓**


BETA
Source: C -14, Cd-109, Pm-147, Tl-204, Bi-210
Platens: ø 0.32 mm, ø 0.40 mm, ø 0.50 mm, ø 0.63 mm, ø 0.80 mm
Appl 2:BETA EX1 | N_tot: 0

Select the aperture platen in use.

☞ The size of the aperture platen (diameter, slot width) is engraved on the aperture ring in metric and USA units (inches).

CON-TINUE


BETA Pm ø 0.63
Calibration with 1 Standard ->
Calibration with 2 Standards ->
Calibration with 3 Standards ->
Calibration with 4 Standards ->
Appl 2:BETA EX1 | N_tot: 0

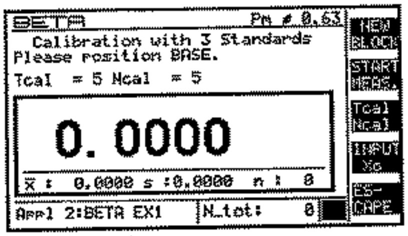
Finish parameter selection and change to the calibration function.

A menu to select the number of calibration standards appears.

Setting-Up an Application / Calibration (Ni/Au)

Key Sequence | **Display** | **Comments**

3



```
BETA                         Pm # 0.63
  Calibration with 3 Standards
Please position BASE.
Tcal  = 5 Ncal  = 5

         0. 0000

x̄ :  0.0000 s :0.0000  n :  0
Appl 2:BETA EX1   |N_tot:     0
```

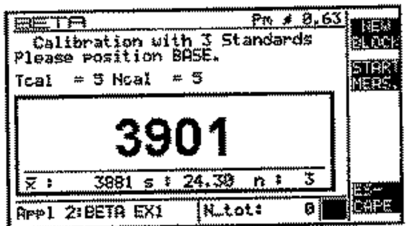
Select the number of standards (number of coated standards only!) in the supplied calibration standard set.

Change to the calibration routine.

☞ The softkey **Tcal Ncal** opens a menu page for changing the measuring time (T_{cal}) and the number of measurements (N_{cal}) for the calibration routine.

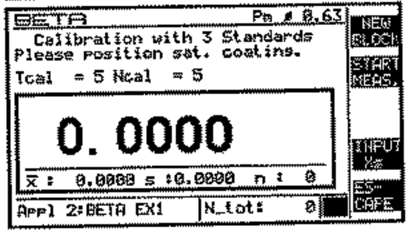
Position Base from the calibration standard set.

START MEAS.



```
BETA                         Pm # 0.63
  Calibration with 3 Standards
Please position BASE.
Tcal  = 5 Ncal  = 5

          3901

x̄ :   3881 s : 24.30  n :  3
Appl 2:BETA EX1   |N_tot:     0
```

Reposition the Base standard after each measurement.

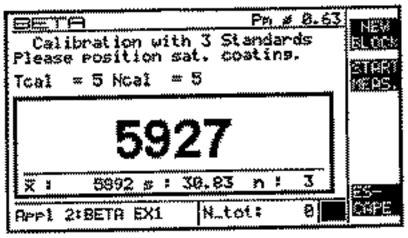


```
BETA                         Pm # 0.63
  Calibration with 3 Standards
Please position sat. coatins.
Tcal  = 5 Ncal  = 5

         0. 0000

x̄ :  0.0000 s :0.0000  n :  0
Appl 2:BETA EX1   |N_tot:     0
```

After the fifth measurement, the menu changes automatically and you will be prompted to position the saturation coating material standard.

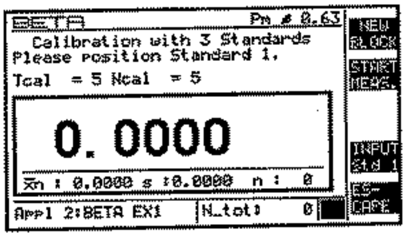
Position the saturation coating material standard (∞) from the calibration standard set.

START MEAS.



```
BETA                         Pm # 0.63
  Calibration with 3 Standards
Please position sat. coatins.
Tcal  = 5 Ncal  = 5

          5927

x̄ :   5992 s : 30.83  n :  3
Appl 2:BETA EX1   |N_tot:     0
```

Reposition the saturation coating material standard after each measurement.

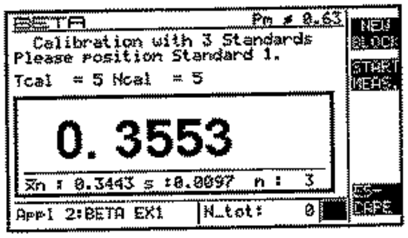


```
BETA                         Pm # 0.63
  Calibration with 3 Standards
Please position Standard 1.
Tcal  = 5 Ncal  = 5

         0. 0000

x̄n : 0.0000 s :0.0000  n :  0
Appl 2:BETA EX1   |N_tot:     0
```

After the fifth measurement, the menu changes automatically and you will be prompted to place the first thickness standard.

Position the first (coated) standard from the calibration standard set (any order).

START MEAS.



```
BETA                         Pm # 0.63
  Calibration with 3 Standards
Please position Standard 1.
Tcal  = 5 Ncal  = 5

         0. 3553

x̄n : 0.3443 s :0.0097  n :  3
Appl 2:BETA EX1   |N_tot:     0
```

Reposition the standard after each measurement.

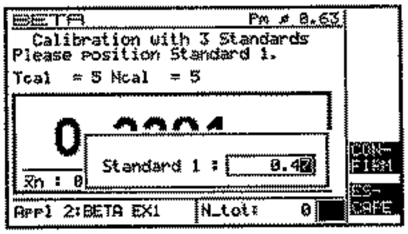
After the fifth measurement a window to enter the coating thickness of the standard will appear automatically.

☞ Enter the thicknesses of the standards always after measuring.

Setting-Up an Application / Calibration (Ni/Au)

Key Sequence **Display** **Comments**

0 . ◂4 7

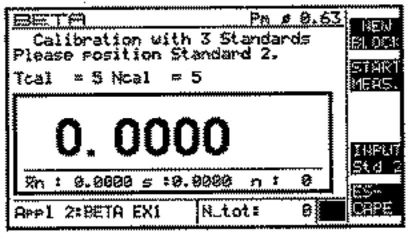


```
BETA                         Pm ø 0.63
  Calibration with 3 Standards
Please position Standard 1.
Tcal   = 5 Ncal   = 5
0.
Xn : 0   Standard 1 : 0.47
Appl 2:BETA EX1        N_tot:      0
```

Enter the coating thickness of the first standard (coating thickness is noted on each standard, 0.47 µm in this example).

☞ Delete erroneous entries with the DEL key.

CON-FIRM

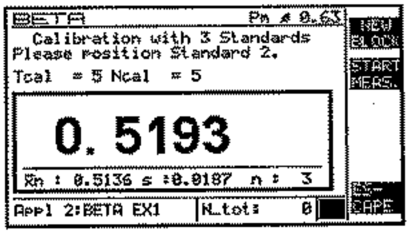


```
BETA                         Pm ø 0.63
  Calibration with 3 Standards
Please position Standard 2.
Tcal   = 5 Ncal   = 5
        0.0000
Xn : 0.0000 s :0.0000  n :  0
Appl 2:BETA EX1        N_tot:      0
```

The menu changes and you will be prompted to place the second standard.

Position the second (coated) standard from the calibration standard set.

START MEAS.

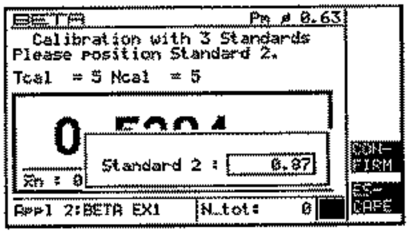


```
BETA                         Pm ø 0.63
  Calibration with 3 Standards
Please position Standard 2.
Tcal   = 5 Ncal   = 5
        0.5193
Xn : 0.5136 s :0.0187  n :  3
Appl 2:BETA EX1        N_tot:      0
```

Reposition the standard after each measurement.

After the fifth measurement a window to enter the coating thickness of the standard will appear automatically.

0 . ▴8 7

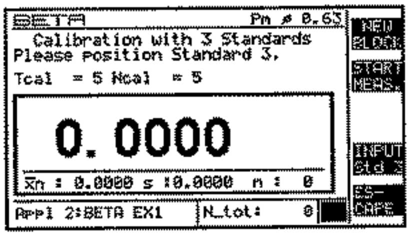


```
BETA                         Pm ø 0.63
  Calibration with 3 Standards
Please position Standard 2.
Tcal   = 5 Ncal   = 5
0.
Xn : 0   Standard 2 : 0.87
Appl 2:BETA EX1        N_tot:      0
```

Enter the coating thickness of the first standard (coating thickness is noted on each standard, 0.87 µm).

☞ Delete erroneous entries with the DEL key.

CON-FIRM



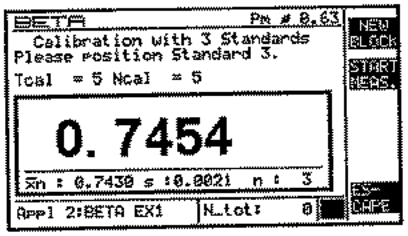
```
BETA                         Pm ø 0.63
  Calibration with 3 Standards
Please position Standard 3.
Tcal   = 5 Ncal   = 5
        0.0000
Xn : 0.0000 s :0.0000  n :  0
Appl 2:BETA EX1        N_tot:      0
```

The menu changes and you will be prompted to place the third standard.

Setting-Up an Application / Calibration (Ni/Au)

Key Sequence | **Display** | **Comments**

Position the third standard from the calibration standard set.
START MEAS.

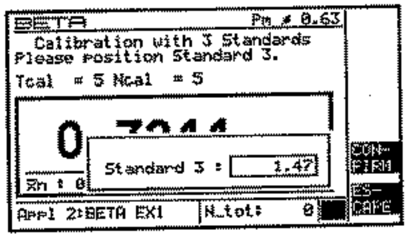


```
BETA                          Pm # 0.63
  Calibration with 3 Standards
Please position Standard 3.
Tcal  = 5 Ncal  = 5
        0. 7454
 x̄n : 0.7430 s :0.0021  n :  3
Appl 2:BETA EX1      N_tot:        0
```

Reposition the standard after each measurement.

After the fifth measurement a window to enter the coating thickness of the standard will appear automatically.

1 . ◂4 7

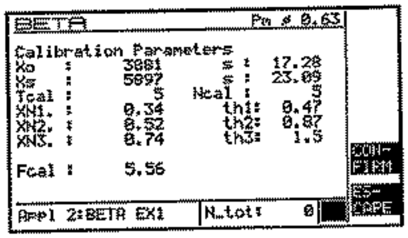


```
BETA                          Pm # 0.63
  Calibration with 3 Standards
Please position Standard 3.
Tcal  = 5 Ncal  = 5
        0
       Standard 3 : [      1.47]
 x̄n : 0
Appl 2:BETA EX1      N_tot:        0
```

Enter the coating thickness of the first standard (coating thickness is noted on each standard, 1.47 µm in this example).

☞ Delete erroneous entries with the DEL key.

CON- FIRM

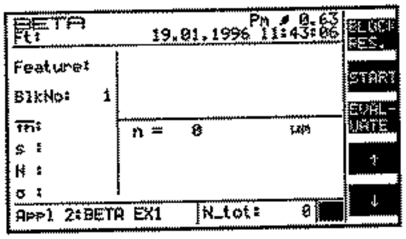


```
BETA                          Pm # 0.63
Calibration Parameters
Xo    :      3881        s :   17.28
Xs    :      5097        s :   23.09
Tcal  :         5   Ncal :       5
XN1.  :      0.34     th1:    0.47
XN2.  :      0.52     th2:    0.87
XN3.  :      0.74     th3:     1.5

Fcal  :      5.56
Appl 2:BETA EX1      N_tot:        0
```

The menu changes and the calibration parameters will be displayed.

The calibration parameters are an indication of the quality of the calibration.

CON- FIRM

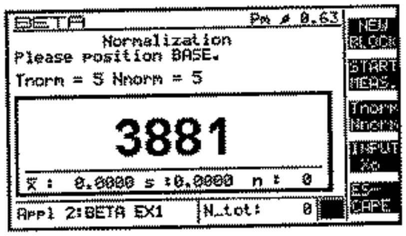


```
BETA                          Pm # 0.63
Ft:              19.01.1996 11:43:06
Feature:
BlkNo:    1
x̄n:           n =   0          µm
s  :
N  :
σ  :
Appl 2:BETA EX1      N_tot:        0
```

Change to the measurement mode of the newly created application number 2, BETA EX1.

Normalization on Substrate (bronze)

ZERO

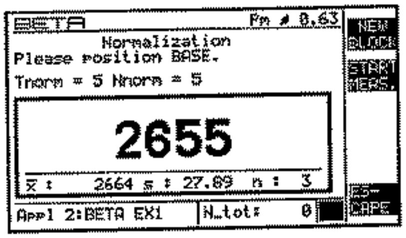


```
BETA                          Pm # 0.63
          Normalization
Please position BASE.
Tnorm = 5 Nnorm = 5
          3881
 x̄ :  0.0000 s :0.0000  n :  0
Appl 2:BETA EX1      N_tot:        0
```

Calls the normalization function.

☞ The softkey Tnorm Nnorm opens a menu page for changing the measuring time (T_{norm}) and the number of measurements (N_{norm}) for the normalization routine.

Measure n times on the **Substrate material** (uncoated bronze piece).
START MEAS.

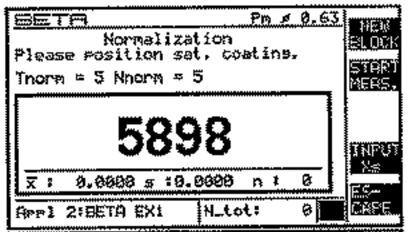


```
BETA                          Pm # 0.63
          Normalization
Please position BASE.
Tnorm = 5 Nnorm = 5
          2655
 x̄ :      2664 s : 27.89  n :  3
Appl 2:BETA EX1      N_tot:        0
```

Reposition the substrate standard after each measurement.

Key Sequence **Display** **Comments**

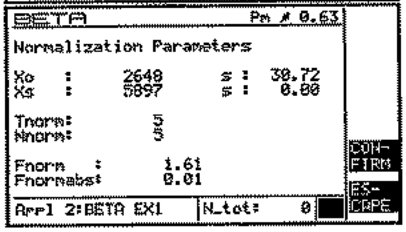
Setting-Up an Application / Normalization on Substrate (Bronze)



```
BETA                     Pm ⌀ 0.63
          Normalization
Please position sat. coating.
Tnorm = 5 Nnorm = 5

              5898
x̄ :   0.0000 s :0.0000   n :   0
Appl 2:BETA EX1      N_tot:      0
```

After the fifth measurement, the menu changes automatically and you will be prompted to place the saturation coating material standard.

ENTER



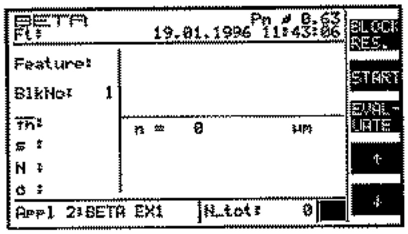
```
BETA                     Pm ⌀ 0.63
Normalization Parameters

Xo    :      2648      s :  30.72
Xs    :      5897      s :   0.00

Tnorm:         5
Nnorm:         5

Fnorm    :      1.61
Fnormabs:       0.01
Appl 2:BETA EX1      N_tot:      0
```

Confirm the countrate for the saturation thickness displayed.

The displayed value need only be accepted, since there are no changes in the coating material.

The normalization parameters will be displayed.

CON-FIRM

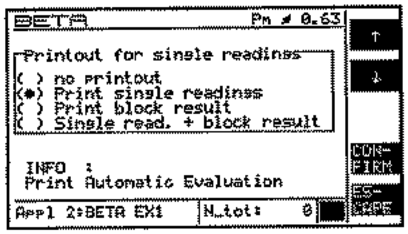


```
BETA                     Pm ⌀ 0.63
Ft:              19.01.1996 11:43:06
Feature:
BlkNo:      1
T̄h:            n =    0          µm
s :
N :
σ :
Appl 2:BETA EX1      N_tot:      0
```

Finish the normalization function, change to the measurement mode of application number 2, BETA EX1.

Defining the Data Output

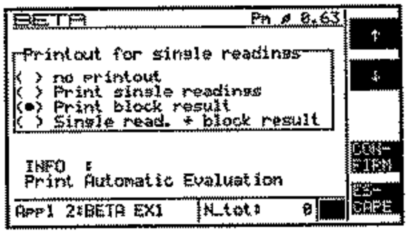
1 **0** **MENU**



```
BETA                     Pm ⌀ 0.63
┌Printout for single readings──────┐
( ) no printout
(●) Print single readings
( ) Print block result
( ) Single read. + block result

 INFO  :
 Print Automatic Evaluation
Appl 2:BETA EX1      N_tot:      0
```

Call menu function 10, 'Printer Output'.

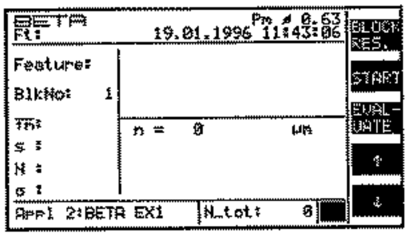
↓



```
BETA                     Pm ⌀ 0.63
┌Printout for single readings──────┐
( ) no printout
( ) Print single readings
(●) Print block result
( ) Single read. + block result

 INFO  :
 Print Automatic Evaluation
Appl 2:BETA EX1      N_tot:      0
```

Select the desired output mode, 'Print Block Result' (document block results without single readings).

CON-FIRM



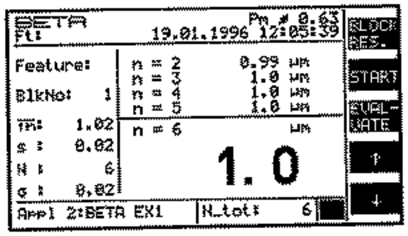
```
BETA                     Pm ⌀ 0.63
Ft:              19.01.1996 11:43:06
Feature:
BlkNo:      1
T̄h:            n =    0          µm
s :
N :
σ :
Appl 2:BETA EX1      N_tot:      0
```

You are now ready to start the measurement process.

Key Sequence

Measurement

Display



```
BETA                          Pm # 0.63
Ft:            19.01.1996 12:05:39
Feature:      n = 2        0.99 µm
              n = 3        1.0 µm
BlkNo:    1   n = 4        1.0 µm
              n = 5        1.0 µm
m:     1.02   n = 6             µm
s :    0.02
N :       6               1.0
σ :    0.02
Appl 2:BETA EX1      N_tot:      6
```

Comments

Position the coated connector contact on the platen and start the measurement with the softkey START or with the GO key of the measuring table.
If the printer is ON, a block (batch) result will be printed after every 5 measurements. Additional for each 5 blocks an evaluation will be printed .

☞ **We recommend to make reference measurements** prior to the actual measurements to prevent measurement errors. 🗐 For greater detail, see Chapter 6.

☞ **If a different measurement precision is required**, e.g., a better calibration uncertainty (F_{cal}), than in this example, a longer measurement time (T_{norm}, T_{cal} or T_{meas}) or a new number of measurements (N_{norm}, N_{cal} or N_{meas}) need to be calculated prior to normalization or measurement. Use menu functions 1, 22, or 20, of the MMS®. 🗐 For greater detail, see Chapter 6.

☞ **Terminate the measurement** by pressing the GO key on the measuring table a second time.

☞ The settings of the menu function 10 apply to all applications. The function settings can be changed at any time.

Example 2 BETA

Measurement of the coating thickness of paint on copper. Expected coating thickness: approx. 140 µm (5.6 mils).

Application:
- Specification limit monitoring
- 5 measurements per block
- Calibrate measuring system for application

A **new application will be created** for the example mentioned above. The respective parameters need to be set. **Calibration** is carried directly **on the substrate material** and with a **calibration standard set of plastic foils.**

For a description of the measurement presentation mode "Specification Limit Display", see Chapter 5, Section "Specification Limit Display".

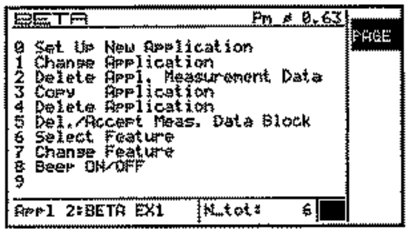
For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys see Chapter 6.

Preparation:
- Find a suitable probe in Table 8_2 of Chapter 8: The Thallium Source TI-204 offers a suitable measurement range for a paint coating with an expected coating thickness of 140 µm (5.6 mils).
- Determine a suitable aperture platen (see Chapter 5, Section "Handling of a Probe" and Chapter 8, Section "Coating Thickness Measurement with the Beta Backscatter Method").
- Install the aperture platen and source in the measuring table (see Chapter 5, Section "Handling of a Probe"). Measuring table used: Z6NGB2.
- Connect the measuring table to the MMS® (BETASCOPE® terminals).
- Switch the MMS® on, **ON** key.

The detector (GM-tube) installed in the measuring table will need at least 15 minutes warm-up time **prior to the measurement** for stable operation. Place the substrate material on the platen, switch the MMS® on, and wait a minimum of 15 minutes. Then the detector will have reached its operating temperature.

Key Sequence	Display	Comments
MENU		Calls the menu function screen. A list with all menu functions is displayed covering several pages.

Set Up an Appl.

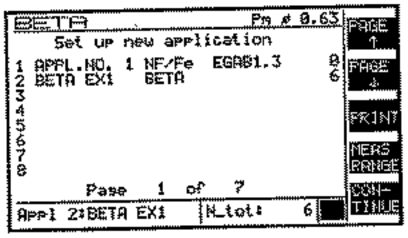


```
BETA                          Pm ø 0.63   PAGE
0 Set Up New Application
1 Change Application
2 Delete Appl. Measurement Data
3 Copy   Application
4 Delete Application
5 Del./Accept Meas. Data Block
6 Select Feature
7 Change Feature
8 Beep ON/OFF
9
Appl 2:BETA EX1       N_tot:      6
```

Setting-Up an Application / Probe selection / Entering Names

Key Selection | **Display** | **Comments**

0 **ENTER**

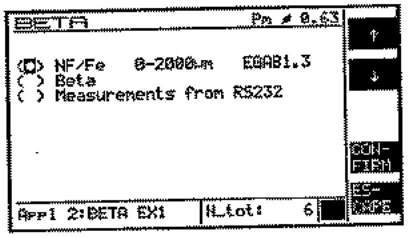


```
BETA                          Pm ø 0.63
     Set up new application
1 APPL.NO. 1 NF/Fe  EGAB1.3          0
2 BETA EX1     BETA                  6
3
4
5
6
7
8
        Page   1  of   7
Appl 2:BETA EX1     |N_tot:        6
```

Enter the number 0 to open the menu function 'Set Up New Application'.

A screen with page 1 of all previously created applications appears.

3 **ENTER**



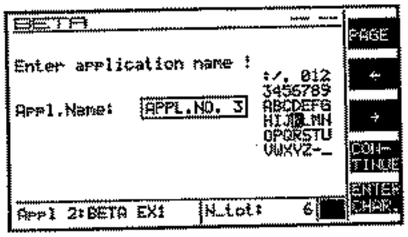
```
BETA                          Pm ø 0.63

<■> NF/Fe    0-2000µm    EGAB1.3
( ) Beta
( ) Measurements from RS232

Appl 2:BETA EX1     |N_tot:        6
```

Enter the number for the new application.

The instrument searches for connected probe models and displays them in a list.

☞ In this example, only a beta probe is connected to the instrument.

CON-FIRM

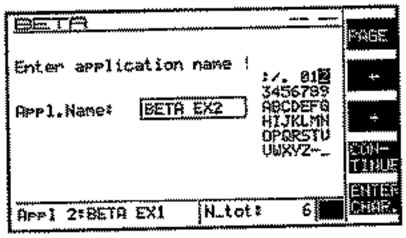


```
BETA

Enter application name !
                               :/. 012
                               3456789
Appl.Name:     APPL.NO. 3      ABCDEFG
                               HIJKLMN
                               OPQRSTU
                               VWXYZ-_

Appl 2:BETA EX1     |N_tot:        6
```

Select the selected probe model (BETA).

A menu page to enter the name of the name of the application will be displayed.

▼2 **◀4** **6▶** **▲8** **ENTER CHAR.**



```
BETA

Enter application name !
                               :/. 012
                               3456789
Appl.Name:     BETA EX2        ABCDEFG
                               HIJKLMN
                               OPQRSTU
                               VWXYZ-_

Appl 2:BETA EX1     |N_tot:        6
```

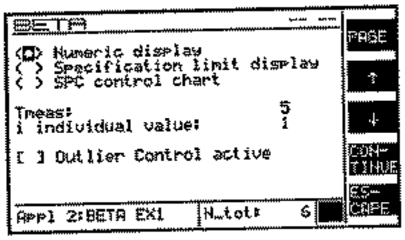
Enter the name for the new application.

For our example: BETA EX2 use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR..

☞ Use the DEL key to delete erroneous entries or unnecessary characters.

On how to enter names see also Chapter 6, page 6-24 .

PAGE

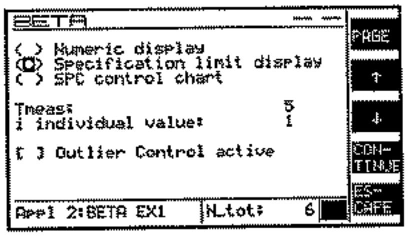


```
BETA
<■> Numeric display
( ) Specification limit display
( ) SPC control chart

Tmeas:                          5
i individual value:             1

[ ] Outlier Control active

Appl 2:BETA EX1     |N_tot:        6
```

Open the next menu page to make additional selections.

Key Selection | **Display** | **Comments**

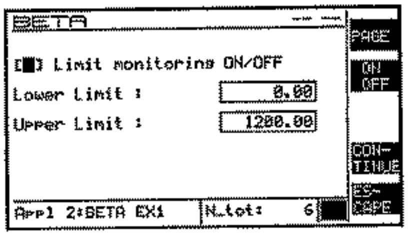
↓



BETA
( ) Numeric display
(●) Specification limit display
( ) SPC control chart
Tmeas: 5
i individual value: 1
[ ] Outlier Control active
Appl 2:BETA EX1 | N_tot: 6

Select "Specification limit display".

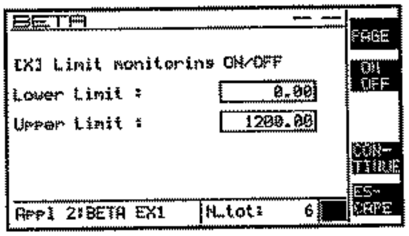
PAGE



BETA
[■] Limit monitoring ON/OFF
Lower Limit : 0.00
Upper Limit : 1200.00
Appl 2:BETA EX1 | N_tot: 6

Open the next menu page to make additional selections.

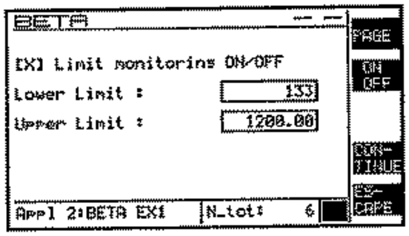
ON OFF



BETA
[X] Limit monitoring ON/OFF
Lower Limit : 0.00
Upper Limit : 1200.00
Appl 2:BETA EX1 | N_tot: 6

Activate specification limit monitoring (audible signal for upper and lower limit violations).

ENTER **1** **3** **3**

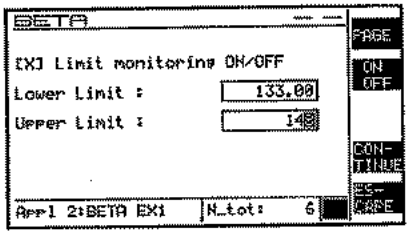


BETA
[X] Limit monitoring ON/OFF
Lower Limit : 133
Upper Limit : 1200.00
Appl 2:BETA EX1 | N_tot: 6

Enter the lower specification limit (133 µm, 5.32 inch).

☞ Use the **DEL** key to delete erroneous entries.

ENTER **1** **◀4** **▲8**

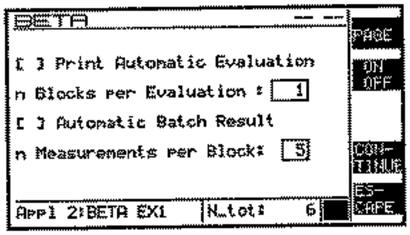


BETA
[X] Limit monitoring ON/OFF
Lower Limit : 133.00
Upper Limit : 148
Appl 2:BETA EX1 | N_tot: 6

Enter the upper specification limit (148 µm, 5.92 inch).

☞ Use the **DEL** key to delete erroneous entries.

PAGE



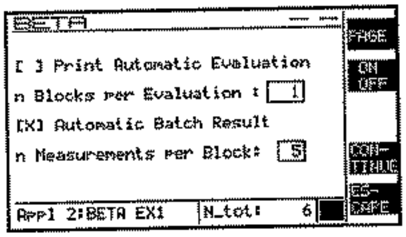
BETA
[ ] Print Automatic Evaluation
n Blocks per Evaluation : 1
[ ] Automatic Batch Result
n Measurements per Block: 5
Appl 2:BETA EX1 | N_tot: 6

Open the next menu page to make additional selections.

Key Selection | **Display** | **Comments**

Setting-Up an Application / Select Source

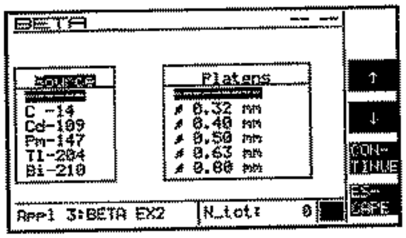
ENTER **ENTER** **ON OFF**



```
BETA
[ ] Print Automatic Evaluation
n Blocks per Evaluation : [ 1]
[X] Automatic Batch Result
n Measurements per Block: [ 5]
Appl 2:BETA EX1      N_tot:      6
```

Activate the automatic block results. 5 Measurements per block is the default value and need not be changed.

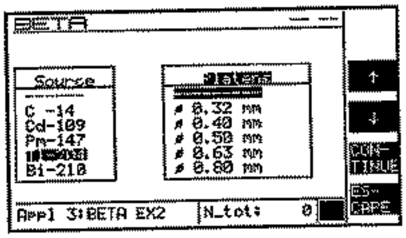
CON-TINUE



```
BETA
 Source        Platens
 C -14         ø 0.32 mm
 Cd-109        ø 0.40 mm
 Pm-147        ø 0.50 mm
 TI-204        ø 0.63 mm
 Bi-210        ø 0.80 mm
Appl 3:BETA EX2      N_tot:      0
```

No additional parameter selections. Change to the specification menu for the source.

Press the **↓** key 4 times.

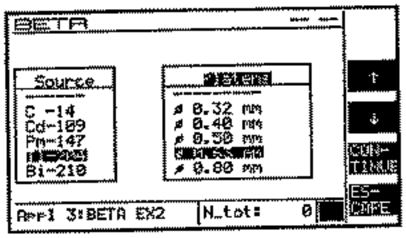


```
BETA
 Source        Platens
 C -14         ø 0.32 mm
 Cd-109        ø 0.40 mm
 Pm-147        ø 0.50 mm
 TI-204        ø 0.63 mm
 Bi-210        ø 0.80 mm
Appl 3:BETA EX2      N_tot:      0
```

Select the source in use.

☞ The source type is engraved on the packaging.

ENTER and press the **↓** key 4 times.



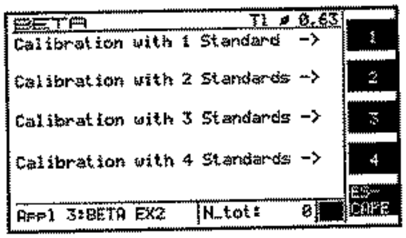
```
BETA
 Source        Platens
 C -14         ø 0.32 mm
 Cd-109        ø 0.40 mm
 Pm-147        ø 0.50 mm
 TI-204        ø 0.63 mm
 Bi-210        ø 0.80 mm
Appl 3:BETA EX2      N_tot:      0
```

Select the aperture ring in use.

☞ The size of the aperture ring (diameter, slot width) is engraved on the aperture ring.

Setting-Up an Application / Calibration

CON-TINUE

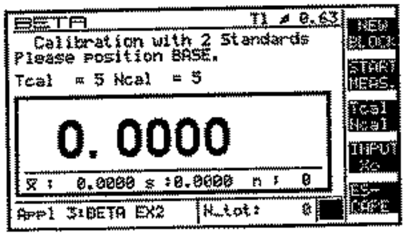


```
BETA                             Tl ø 0.63
Calibration with 1 Standard  ->
Calibration with 2 Standards ->
Calibration with 3 Standards ->
Calibration with 4 Standards ->
Appl 3:BETA EX2      N_tot:      0
```

Finish parameter definition and change to the calibration function.

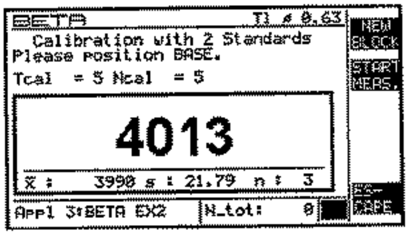
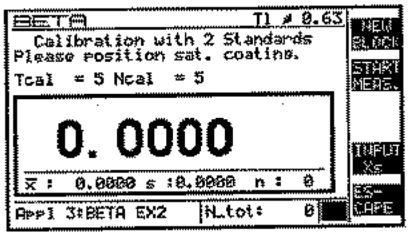
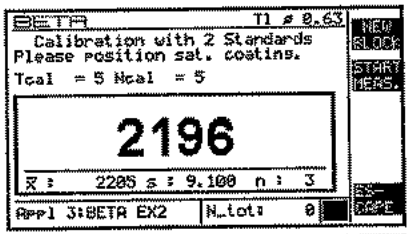
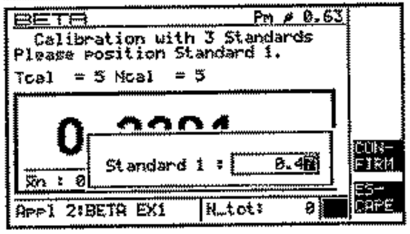
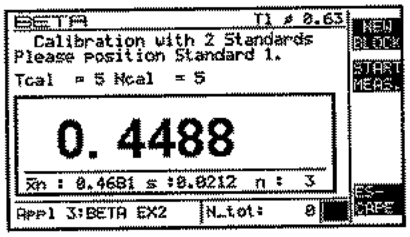
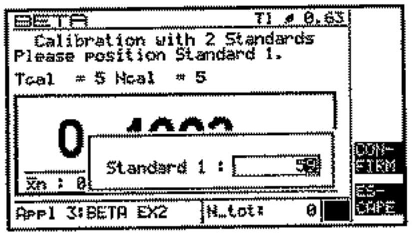
A menu to select the number of standards appears.

2



```
BETA                             Tl ø 0.63
  Calibration with 2 Standards
Please position BASE.
Tcal   = 5 Ncal   = 5
      0.0000
 x̄ :   0.0000 s :0.0000  n :   0
Appl 3:BETA EX2      N_tot:      0
```

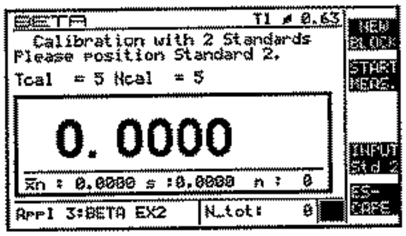
Select the number of standards = number of foil standards marked with a thickness of the supplied calibration standard set.

Key Selection	Display	Comments
Position Base = uncoated copper.	 BETA Tl ⌀ 0.63 Calibration with 2 Standards Please position BASE. Tcal = 5 Ncal = 5 4013 x̄ : 3990 s : 21.79 n : 3 Appl 3:BETA EX2 N_tot: 0 NEW BLOCK START MEAS. ES-CAPE	**Reposition the Base standard after each measurement,** or reposition the platen opening (depending on the measuring table in use).
	 BETA Tl ⌀ 0.63 Calibration with 2 Standards Please position sat. coating. Tcal = 5 Ncal = 5 0.0000 x̄ : 0.0000 s :0.0000 n : 0 Appl 3:BETA EX2 N_tot: 0 NEW BLOCK START MEAS. INPUT Xs ES-CAPE	After the fifth measurement, the menu changes automatically and you will be prompted to position the saturation coating material standard.
Position the saturation coating material standard (∞) for measurement.	 BETA Tl ⌀ 0.63 Calibration with 2 Standards Please position sat. coating. Tcal = 5 Ncal = 5 2196 x̄ : 2205 s : 9.100 n : 3 Appl 3:BETA EX2 N_tot: 0 NEW BLOCK START MEAS. ES-CAPE	**Reposition the saturation coating material standard after each measurement,** or reposition the platen opening (depending on the measuring table in use).
	 BETA Pm ⌀ 0.63 Calibration with 3 Standards Please position Standard 1. Tcal = 5 Ncal = 5 Standard 1 : 0.4 x̄n : 0 Appl 2:BETA EX1 N_tot: 0 CON-FIRM ES-CAPE	After the fifth measurement, the menu changes automatically and you will be prompted to position the first standard.
Position the first standard from the calibration standard set (any order).	 BETA Tl ⌀ 0.63 Calibration with 2 Standards Please position Standard 1. Tcal = 5 Ncal = 5 0.4488 x̄n : 0.4681 s :0.0212 n : 3 Appl 3:BETA EX2 N_tot: 0 NEW BLOCK START MEAS. ES-CAPE	**Reposition the standard after each measurement.** After the fifth measurement, a window to enter the coating thickness of the standard will appear automatically.
5 9	 BETA Tl ⌀ 0.63 Calibration with 2 Standards Please position Standard 1. Tcal = 5 Ncal = 5 Standard 1 : 59 x̄n : 0 Appl 3:BETA EX2 N_tot: 0 CON-FIRM ES-CAPE	**Enter the coating thickness of the first standard.** (Coating thickness is noted on each standard, 59 µm, in this example). ☞ Delete erroneous entries with the DEL key.

Setting-Up an Application / Calibration (Foil/Cu)

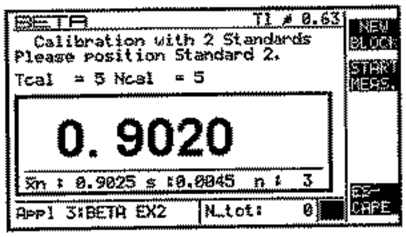
Key Selection **Display** **Comments**

CON-FIRM


```
BETA                          T1 ⌀ 0.63
  Calibration with 2 Standards
Please position Standard 2.
Tcal   = 5 Ncal   = 5

      0. 0000

x̄n : 0.0000 s :0.0000  n :   0
Appl 3:BETA EX2      N.tot:       0
```

Accept the coating thickness value entered - you will be prompted to place the second standard.

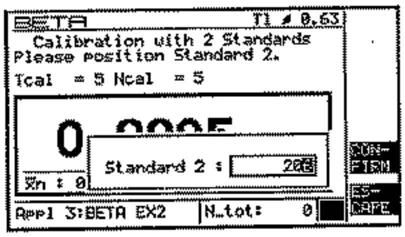
Position the first standard from the calibration standard set.


```
BETA                          T1 ⌀ 0.63
  Calibration with 2 Standards
Please position Standard 2.
Tcal   = 5 Ncal   = 5

      0. 9020

x̄n : 0.9025 s :0.0045  n :   3
Appl 3:BETA EX2      N.tot:       0
```

Reposition the standard after each measurement.

After the fifth measurement, a window to enter the coating thickness of the standard will appear automatically.

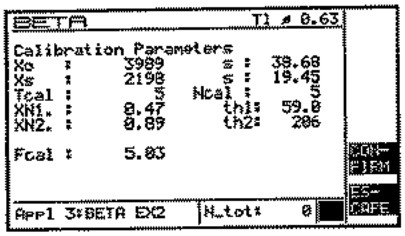
▼2 **0** **6▶**


```
BETA                          T1 ⌀ 0.63
  Calibration with 2 Standards
Please position Standard 2.
Tcal   = 5 Ncal   = 5

      0

     Standard 2 :       206
x̄n : 0
Appl 3:BETA EX2      N.tot:       0
```

Enter the coating thickness of the second standard (coating thickness is noted on each standard, 206 µm, in this example).

☞ Delete erroneous entries with the **DEL** key.

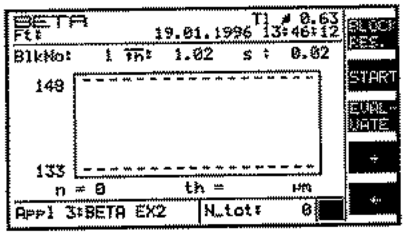
CON-FIRM


```
BETA                          T1 ⌀ 0.63

Calibration Parameters
Xo    :      3989       s :   38.68
Xs    :      2198       s :   19.45
Tcal  :         5    Ncal :       5
XN1.  :      0.47     th1:   59.0
XN2.  :      0.89     th2:    206

Fcal  :      5.03

Appl 3:BETA EX2      N.tot:       0
```

Accept the coating thickness value entered, the menu changes - display of the calibration parameters.

The calibration parameters are an indication of the quality of the calibration.

CON-FIRM


```
BETA                          T1 ⌀ 0.63
Ft:              19.01.1996 13:46:12
BlkNo:     1 x̄n:   1.02    s :   0.02
```

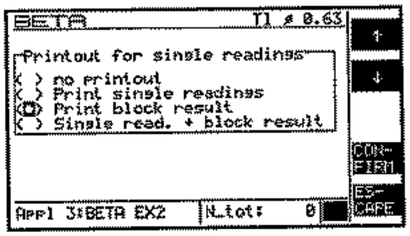
```
Appl 3:BETA EX2      N.tot:       0
```

Accept parameters and calibration entered, change to the measurement mode of the newly created application number 3, BETA EX2.

Key Selection | **Display** | **Comments**

Determine Data Output

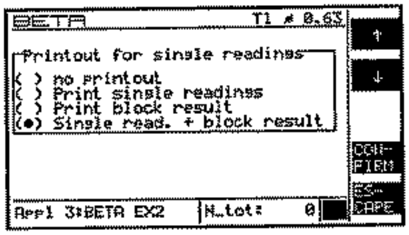
1 **0** **MENU**



```
BETA                              T1 ≠ 0.63
Printout for single readings
( ) no printout
( ) Print single readings
(●) Print block result
( ) Single read. + block result
Appl 3:BETA EX2       N_tot:        0
```

Call menu function 10, 'Printer Output', to select the desired output data.

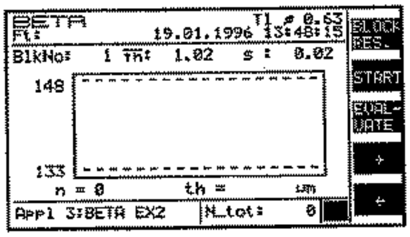
↓



```
BETA                              T1 ≠ 0.63
Printout for single readings
( ) no printout
( ) Print single readings
( ) Print block result
(●) Single read. + block result
Appl 3:BETA EX2       N_tot:        0
```

Select the desired output mode, 'Single read. + block result' (documenting all single readings and block results).

CON-FIRM

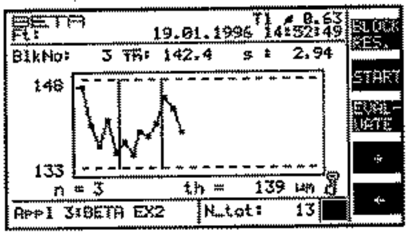


```
BETA                              T1 ≠ 0.63
Ft:                   19.01.1996 13:48:15
BlkNo:    1 TH:   1.02    s :   0.02
   148
   133
     n = 0           th =          um
Appl 3:BETA EX2       N_tot:        0
```

Accept the settings, change to the measurement mode of application number 3, BETA EX2.

You are now ready to start the measurement process.

Measurement



```
BETA                              T1 ≠ 0.63
Ft:                   19.01.1996 14:52:49
BlkNo:    3 TH: 142.4    s :   2.94
   148
   133
     n = 3           th =     139 um
Appl 3:BETA EX2       N_tot:       13
```

Position the coated copper pieces on the platen aperture and start the measurement with the softkey **START** or with the GO key of the measuring table.

☞ We recommend to make reference measurements prior to the actual measurements to prevent measurement errors. 📖 For more details, see Chapter 6.

☞ **If a different measurement precision is required,** e.g., a better calibration uncertainty (Fcal) than in this example, a longer measurement time (T_{norm}, T_{cal} or T_{meas}) or a new number of measurements (N_{norm}, N_{cal} or N_{meas}) need to be calculated. Use menu function 1, 20 or 22 of the MMS®. 📖 For more details, see Chapter 6.

☞ **Cancel the measurement** by pressing the GO key on the measuring table a second time.

☞ The settings of the menu function 10 apply to all applications. The function settings can be changed at any time.

Example 1 FERITSCOPE®

Measurement of the ferrite content.

Application:
- Numeric display
- Specification limit monitoring
- Normalize measuring system for application

A new application will be created for the measurement application mentioned above. **Parameters need to be set** according to the application. **Normalization** is carried out **on a Base standard with approx. 140 WRC-FN ferrite content.**

For description of the measurement presentation mode "Numeric Display", see Chapter 5, Section "Numeric Display".

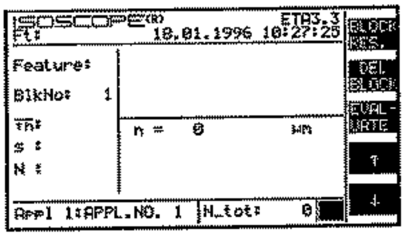
For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys, see Chapter 6.

Further Information about the measurement of the ferrite contents will you find in Chapter 10.

Preparation:
- A model EGAB1.3-Fe probe is used for this measurement application.
- Connect the probe to the MMS®.
- Switch the MMS® on, **ON** key.

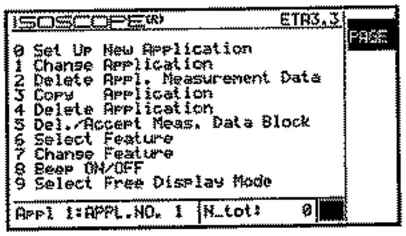
Key Sequence **Display** **Comments**

Setting-Up an Application


```
ISOSCOPE(R)                    ETA3.3
Ft:             18.01.1996 10:27:25
Feature:
BlkNo:      1
 n:           n =    0          µm
s :
N :
Appl 1:APPL.NO. 1  |N_tot:       0
```

Measurement application number 1.

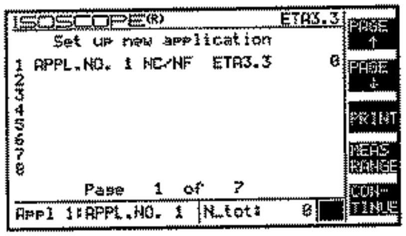
MENU


```
ISOSCOPE(R)                    ETA3.3
0 Set Up New Application
1 Change Application
2 Delete Appl. Measurement Data
3 Copy   Application
4 Delete Application
5 Del./Accept Meas. Data Block
6 Select Feature
7 Change Feature
8 Beep ON/OFF
9 Select Free Display Mode
Appl 1:APPL.NO. 1  |N_tot:       0
```

Calls the menu function screen.

A list with all menu functions is displayed covering several pages.

0 **ENTER**


```
ISOSCOPE(R)                    ETA3.3
    Set up new application
1 APPL.NO. 1 NC/NF  ETA3.3        0
2
3
4
5
6
7
8
       Page   1  of   7
Appl 1:APPL.NO. 1  |N_tot:       0
```

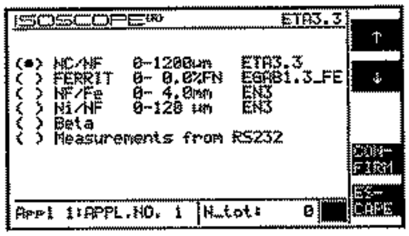
Enter the number 0 to open the menu function 'Set Up New Application'.

A screen with page 1 of all previously created applications appears.

Setting-Up an Application / Probe Selection / Entering Names

Key Selection | Display | Comments

▼2 **ENTER**

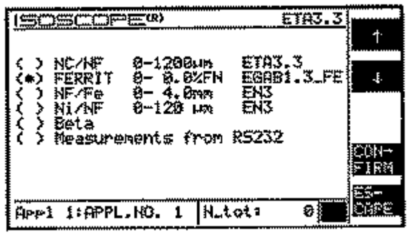


```
ISOSCOPE(R)                ETA3.3
(•) NC/NF    0-1200µm    ETA3.3
( ) FERRIT   0- 0.0%FN   EGAB1.3_FE
( ) NF/Fe    0- 4.0mm    EN3
( ) Ni/NF    0-120 µm    EN3
( ) Beta
( ) Measurements from RS232
Appl 1:APPL.NO. 1  |N_tot:     0
```

Enter the number for the new application.

The instrument searches for connected probe models and displays them in a list.

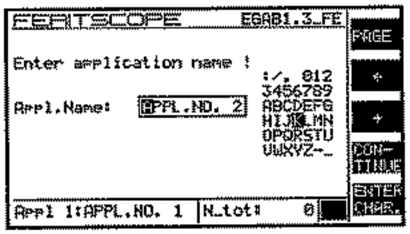
↓



```
ISOSCOPE(R)                ETA3.3
( ) NC/NF    0-1200µm    ETA3.3
(•) FERRIT   0- 0.0%FN   EGAB1.3_FE
( ) NF/Fe    0- 4.0mm    EN3
( ) Ni/NF    0-120 µm    EN3
( ) Beta
( ) Measurements from RS232
Appl 1:APPL.NO. 1  |N_tot:     0
```

☞ The probes listed here serve as an example only. The actual list depends on the instrument system and the connected probes.

CON-FIRM



```
FERITSCOPE              EGAB1.3_FE
Enter application name !
                              :/. 012
                              3456789
Appl.Name:   [APPL.NO. 2]     ABCDEFG
                              HIJKLMN
                              OPQRSTU
                              VWXYZ-_
Appl 1:APPL.NO. 1  |N_tot:     0
```

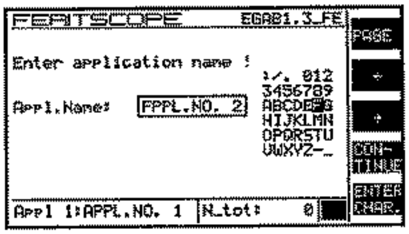
Confirm the probe selection.

A menu page to enter the name of the new application will be displayed.

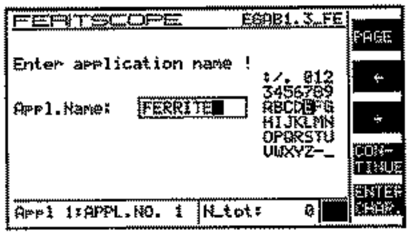
▼2 **◀4**

6▶ **▲8**

ENTER CHAR.



```
FERITSCOPE              EGAB1.3_FE
Enter application name !
                              :/. 012
                              3456789
Appl.Name:   [FPPL.NO. 2]     ABCDEFG
                              HIJKLMN
                              OPQRSTU
                              VWXYZ-_
Appl 1:APPL.NO. 1  |N_tot:     0
```



```
FERITSCOPE              EGAB1.3_FE
Enter application name !
                              :/. 012
                              3456789
Appl.Name:   [FERRITE█ ]      ABCDEFG
                              HIJKLMN
                              OPQRSTU
                              VWXYZ-_
Appl 1:APPL.NO. 1  |N_tot:     0
```

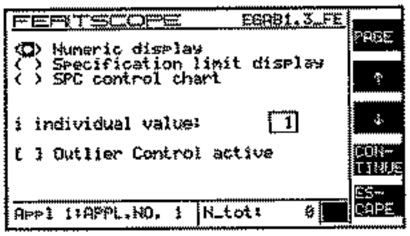
For our example: FERRITE.

Use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR. .

☞ Use the DEL key to delete erroneous entries or unnecessary characters.

On how to enter names, see also Chapter 6, page 6-24.

PAGE

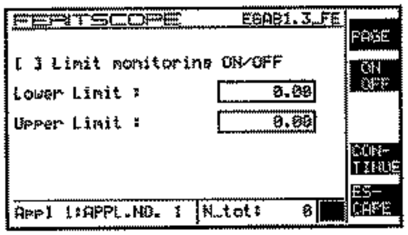
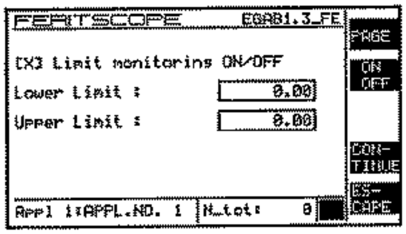
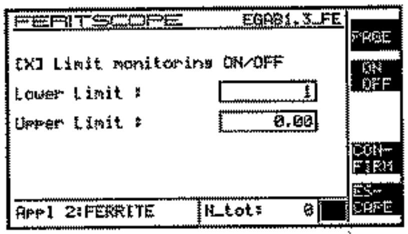
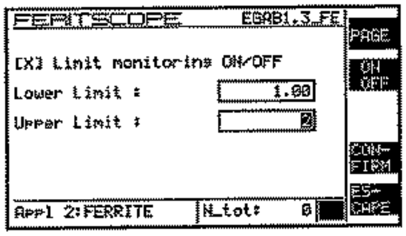


```
FERITSCOPE              EGAB1.3_FE
(•) Numeric display
( ) Specification limit display
( ) SPC control chart

i individual value:        [ 1]

[ ] Outlier Control active

Appl 1:APPL.NO. 1  |N_tot:     0
```

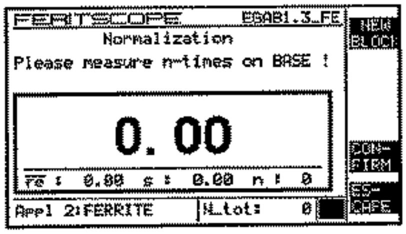
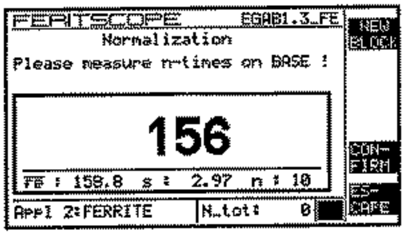
Open the next menu page to make additional selections.

No settings on this page will be changed.

Setting-Up an Application / Parameter Definition

Key Selection	Display	Comments
PAGE	 FERITSCOPE EGAB1.3_FE [ ] Limit monitoring ON/OFF Lower Limit : 0.00 Upper Limit : 0.00 Appl 1:APPL.NO. 1 | N_tot: 0 	Open the next menu page to make additional selections.
ON OFF	 FERITSCOPE EGAB1.3_FE [X] Limit monitoring ON/OFF Lower Limit : 0.00 Upper Limit : 0.00 Appl 1:APPL.NO. 1 | N_tot: 0 	Activate specification limit monitoring (audible signal for upper and lower limit violations).
ENTER **1**	 FERITSCOPE EGAB1.3_FE [X] Limit monitoring ON/OFF Lower Limit : 1 Upper Limit : 0.00 Appl 2:FERRITE | N_tot: 0 	Enter the lower specification limit (1 WRC-FN ferrite content). ☞ Use the DEL key to delete erroneous entries.
ENTER **▼2**	 FERITSCOPE EGAB1.3_FE [X] Limit monitoring ON/OFF Lower Limit : 1.00 Upper Limit : 2 Appl 2:FERRITE | N_tot: 0 	Enter the upper specification limit (2 WRC-FN ferrite content). ☞ Use the DEL key to delete erroneous entries.

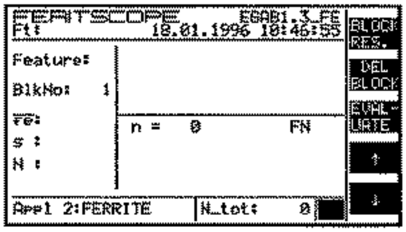
Setting-Up an Application / Normalization

Key Selection	Display	Comments
CON-FIRM	 FERITSCOPE EGAB1.3_FE Normalization Please measure n-times on BASE ! 0.00 $\overline{Fe}$: 0.00 s : 0.00 n : 0 Appl 2:FERRITE | N_tot: 0 	Finish parameter definition and change to the normalization routine.
Measure n times on the Base standard with an approx. 140 FN ferrite content.	 FERITSCOPE EGAB1.3_FE Normalization Please measure n-times on BASE ! 156 $\overline{Fe}$: 158.8 s : 2.97 n : 10 Appl 2:FERRITE | N_tot: 0 	Repeat the measurement until the reading changes only slightly or not at all.

Key Selection **Display** **Comments**

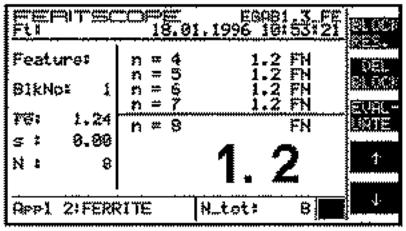
Measurement

CON-FIRM



```
FERITSCOPE          EGAB1.3_FE
Ft:        18.01.1996 10:46:55
Feature:
BlkNo:    1
Fe:            n =   0        FN
s :
N :
Appl 2:FERRITE    N_tot:    0
```

Finish normalization and change to the measurement mode of the newly created application number 2, FERRITE.



```
FERITSCOPE          EGAB1.3_FE
Ft:        18.01.1996 10:53:21
Feature:       n = 4      1.2 FN
               n = 5      1.2 FN
BlkNo:    1    n = 6      1.2 FN
               n = 7      1.2 FN
Fe:    1.24    n = 8          FN
s :    0.00
N :       8             1.2
Appl 2:FERRITE    N_tot:    8
```

You are now ready to start the measurement process.

☞ To verify normalization we recommend to perform a reference measurement.

Example 1 SIGMASCOPE®

Measurement of the electrical conductivity on non-ferrous metals without temperature compensation. The temperature of the specimen is assumed to be 20 °C (68 °F).

Application:
- Numeric display
- Normalize measuring system for application.

A **new application will be created** for the above mentioned measurement application. Since numeric display is the default setting, no parameters need to be changed. **Normalization** is performed **on** the **copper standard** (Cu conductivity standard, included with the probe shipment).

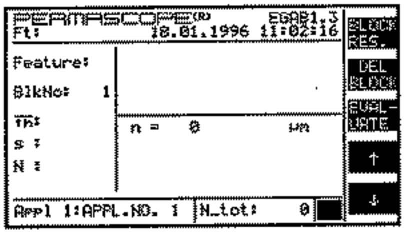
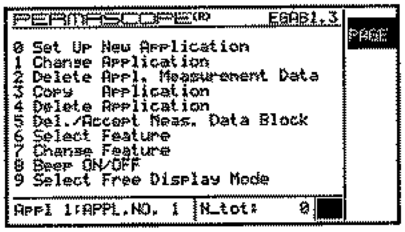
For a description of the measurement presentation mode "Numeric Display", see Chapter 5, Section "Numeric Display".

For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys, see Chapter 6.

Further Information about the measurement of the electrical conductivity on non-ferrous metals will you find in Chapter 9.

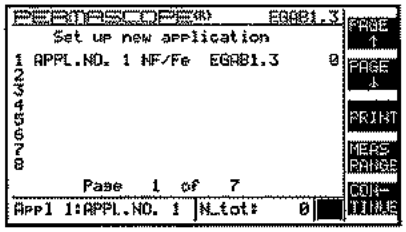
Preparation:
- The electrical conductivity probe ES1A is used for this measurement application.
- Connect the probe to the MMS® (SIGMASCOPE® probe socket).
- Switch the MMS® on, ON key.

Setting-Up an Application

Key Sequence	Display	Comments
		Measurement mode of application number 1.
MENU		Calls the menu function screen. A list with all menu functions is displayed covering several pages.

Key Selection | **Display** | **Comments**

0 **ENTER**

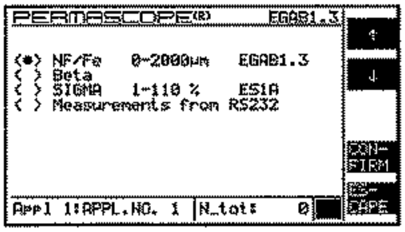


```
PERMASCOPE(R)                 EGAB1.3
     Set up new application
1 APPL.NO. 1 NF/Fe  EGAB1.3        0
2
3
4
5
6
7
8
        Page   1   of   7
Appl 1:APPL.NO. 1 |N_tot:         0
```

Enter the number 0 to open the menu function 'Set Up New Application'.

A screen with page 1 of all previously created applications appears.

▼2 **ENTER**



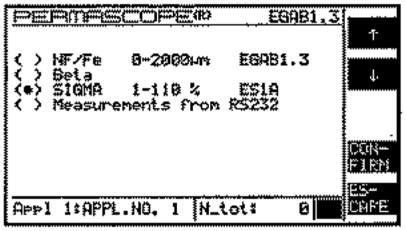
```
PERMASCOPE(R)                 EGAB1.3

<•> NF/Fe     0-2000µm    EGAB1.3
< > Beta
< > SIGMA     1-110 %     ES1A
< > Measurements from RS232




Appl 1:APPL.NO. 1 |N_tot:         0
```

Enter the number for the new application.

The instrument searches for connected probe models and displays them in a list.

☞ The probes listed here serve as examples only. The actual list depends on the instrument setup and the connected probes.

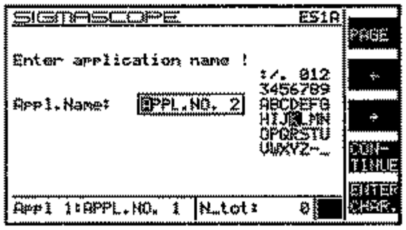
↓ **↓**



```
PERMASCOPE(R)                 EGAB1.3

< > NF/Fe     0-2000µm    EGAB1.3
< > Beta
<•> SIGMA     1-110 %     ES1A
< > Measurements from RS232




Appl 1:APPL.NO. 1 |N_tot:         0
```

Select the probe model (SIGMA ... ES1A).

CON-FIRM



```
SIGMASCOPE                       ES1A

Enter application name !
                              :/. 012
                              3456789
Appl.Name:    [APPL.NO. 2]    ABCDEFG
                              HIJKLMN
                              OPQRSTU
                              VWXYZ-_


Appl 1:APPL.NO. 1 |N_tot:         0
```

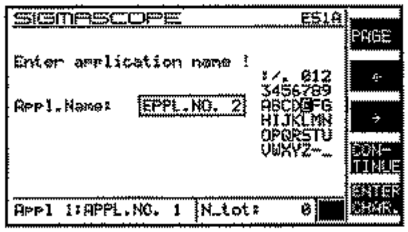
Confirm the selected probe model (ES1A).

A menu page to enter the name of the new application will be displayed.

▼2 **◀4**

6▶ **▲8**

ENTER CHAR.

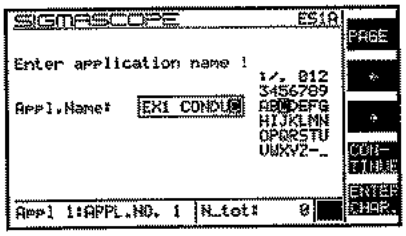


```
SIGMASCOPE                       ES1A

Enter application name !
                              :/. 012
                              3456789
Appl.Name:    [EPPL.NO. 2]    ABCDEFG
                              HIJKLMN
                              OPQRSTU
                              VWXYZ-_


Appl 1:APPL.NO. 1 |N_tot:         0
```

For our example: EX1 CONDUC. Use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR .

Key Selection **Display** **Comments**

Setting-Up an Application / Entering Names



```
SIGMASCOPE                 ES1A   PAGE
Enter application name !
                        !/, 012
                        3456789
Appl.Name:  EX1 CONDUC  ABCDEFG   CON-
                        HIJKLMN   TINUE
                        OPQRSTU
                        VWXYZ-_   ENTER
Appl 1:APPL.NO. 1 |N_tot:  0      CHAR.
```

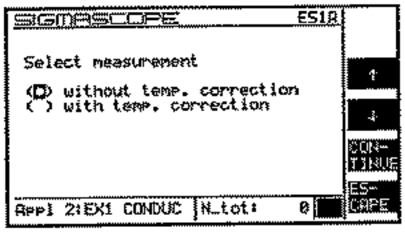
☞ Use the **DEL** key to delete erroneous entries or unnecessary characters.

On how to enter names, see also Chapter 6, page 6-24.

PAGE

Use the **PAGE** softkey to open 5 additional menu pages to enter/select parameters.

CON-TINUE

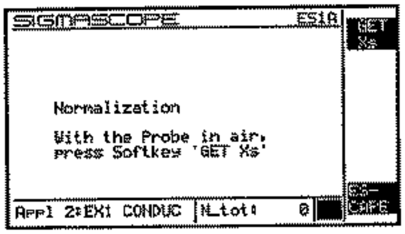


```
SIGMASCOPE                 ES1A
Select measurement
(●) without temp. correction
( ) with temp. correction         CON-
                                  TINUE
                                  ES-
Appl 2:EX1 CONDUC |N_tot:  0      CAPE
```

No additional parameter selections.

Setting-Up an Application / Normalization

CON-TINUE

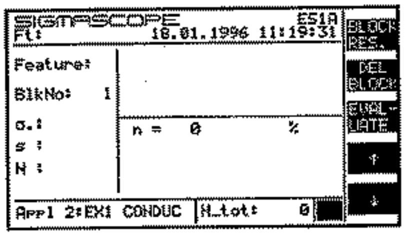


```
SIGMASCOPE                 ES1A   GET
                                  Xs
     Normalization

     With the Probe in air,
     press Softkey 'GET Xs'
                                  ES-
Appl 2:EX1 CONDUC |N_tot:  0      CAPE
```

Change to the normalization routine.

Hold probe in air and press the softkey **GET Xs**.

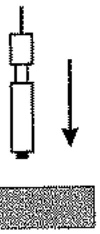
The countrate for probe in air will be confirmed.

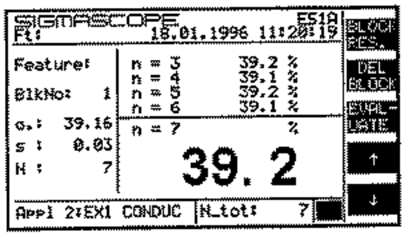


```
SIGMASCOPE                 ES1A   BLOCK
Ft:         18.01.1996 11:19:31   RES.
Feature:  |                       DEL
BlkNo:   1|                       BLOCK
σ.:       | n =   0         %     EVAL-
s :       |                       UATE
N :       |
Appl 2:EX1 CONDUC |N_tot:  0
```

Save the new application and normalization. Change to the measurement mode of the new application number 2, EX1 CONDUC.

Measurement





```
SIGMASCOPE                 ES1A   BLOCK
Ft:         18.01.1996 11:20:19   RES.
Feature:     | n = 3     39.2 %   DEL
BlkNo:     1 | n = 4     39.1 %   BLOCK
             | n = 5     39.2 %
             | n = 6     39.1 %   EVAL-
σ.:   39.16  | n = 7          %   UATE
s :    0.03  |
N :       7  |      39.2
Appl 2:EX1 CONDUC |N_tot:  7
```

You are now ready to start the measurement process.

☞ We recommend to make reference measurements prior to the actual measurements to prevent measurement errors. For more detail see Chapter 6, page 6-34.

Example 2 SIGMASCOPE®

Measurement of the electrical conductivity on non-ferrous metals with temperature compensation.

Application:
- Numeric display
- Temperature compensation
- Normalize measuring system for application.

A **new application will be created** for the above mentioned measurement application. Parameters must be set according to the above measurement application. **Normalization** is performed **on** the **copper standard** (Cu conductivity standard, included with the probe shipment).

For a description of the measurement presentation mode Numeric Display, see Chapter 5, Section "Numeric Display".

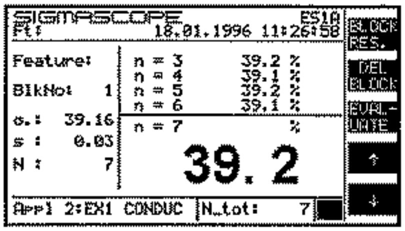
For a description of the instrument operation (calling menu functions, etc.), instrument functions, and softkeys, see Chapter 6.

Further Information about the measurement of the electrical conductivity on non-ferrous metals will you find in Chapter 9.

Preparation:
- The electrical conductivity probe ES1A is used for this measurement application.
- Connect the probe to the MMS® (SIGMASCOPE® probe socket).
- Switch the MMS® on, ON key.

Setting-Up an Application

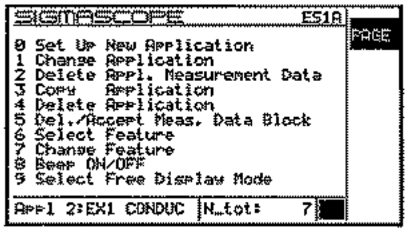
Key Selection **Display** **Comments**



```
SIGMASCOPE                    ES1A
Ft:          18.01.1996 11:26:58
Feature:    n = 3        39.2 %
            n = 4        39.1 %
BlkNo:   1  n = 5        39.2 %
            n = 6        39.1 %
σ.:  39.16  n = 7             %
s :   0.03
N :      7          39.2
Appl 2:EX1 CONDUC  N_tot:     7
```

Measurement mode of application number 1.

MENU



```
SIGMASCOPE                    ES1A
0 Set Up New Application
1 Change Application
2 Delete Appl. Measurement Data
3 Copy   Application
4 Delete Application
5 Del./Accept Meas. Data Block
6 Select Feature
7 Change Feature
8 Beep ON/OFF
9 Select Free Display Mode
Appl 2:EX1 CONDUC  N_tot:     7
```

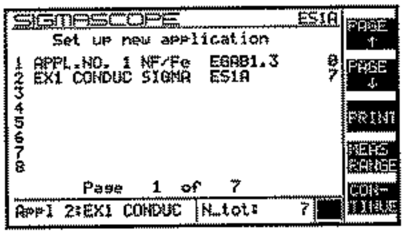
Calls the menu function screen.

A list with all menu functions is displayed covering several pages.

Setting-Up an Application / Probe selection / Entering Names

Key Selection **Display** **Comments**

0 ENTER

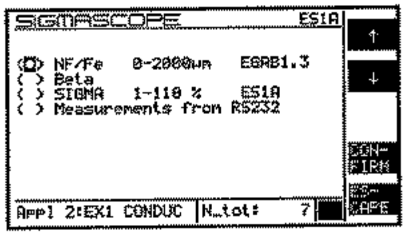


```
SIGMASCOPE                         ES1A
     Set up new application
1 APPL.NO. 1 NF/Fe  EGAB1.3       0
2 EX1 CONDUC SIGMA  ES1A          7
3
4
5
6
7
8
           Page   1  of   7
Appl 2:EX1 CONDUC  |N..tot:       7
```

Enter the number 0 to open the menu function 'Set Up New Application'.

A screen with page 1 of all previously created applications appears.

3 ENTER



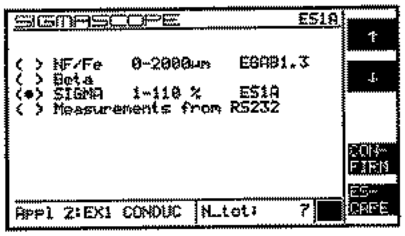
```
SIGMASCOPE                         ES1A

(□) NF/Fe    0-2000um    EGAB1.3
( ) Beta
( ) SIGMA    1-110 %     ES1A
( ) Measurements from RS232

Appl 2:EX1 CONDUC  |N..tot:       7
```

Enter the number for the new application.

The instrument searches for connected probe models and displays them in a list.

☞ The probes listed here serve as examples only. The actual list depends on the instrument setup and the connected probes.

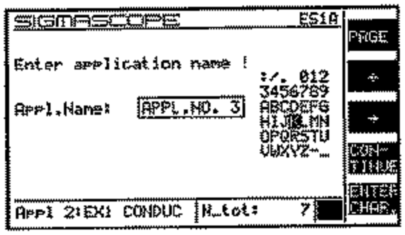
↓ ↓



```
SIGMASCOPE                         ES1A

( ) NF/Fe    0-2000um    EGAB1.3
( ) Beta
(•) SIGMA    1-110 %     ES1A
( ) Measurements from RS232

Appl 2:EX1 CONDUC  |N..tot:       7
```

Select the probe model (SIGMA ... ES1A).

CON-FIRM



```
SIGMASCOPE                         ES1A

Enter application name !
                                :/. 012
                                3456789
Appl.Name:    |APPL.NO. 3|      ABCDEFG
                                HIJKLMN
                                OPQRSTU
                                VWXYZ-_

Appl 2:EX1 CONDUC  |N..tot:       7
```

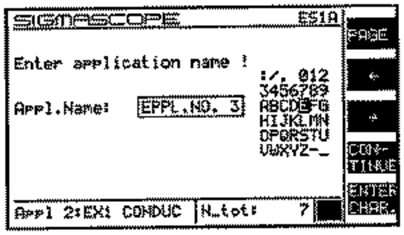
Confirm the selected probe model (ES1A).

A menu page to enter the name of the new application will be displayed.

▼2 ◀4

6▶ ▲8

ENTER CHAR.

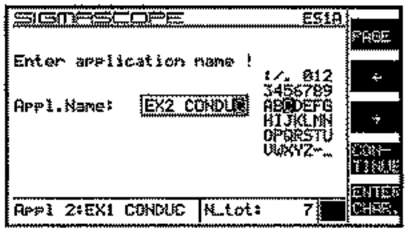


```
SIGMASCOPE                         ES1A

Enter application name !
                                :/. 012
                                3456789
Appl.Name:    |EPPL.NO. 3|      ABCDEFG
                                HIJKLMN
                                OPQRSTU
                                VWXYZ-_

Appl 2:EX1 CONDUC  |N..tot:       7
```

For our example: EX2 CONDUC. use the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad to move the highlight in the alphanumeric character field to the desired character. Accept the character with the softkey ENTER CHAR. .

Key Selection | **Display** | **Comments**

Setting-Up an Appl. / Selection of the Temp. Compensation

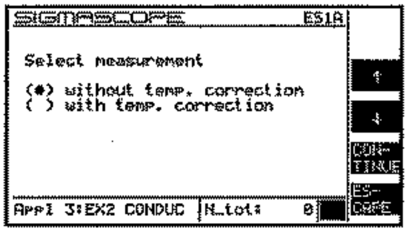


```
SIGMASCOPE                         ES1A
Enter application name !
                               :/. 012
                               3456789
Appl.Name:     EX2 CONDU█      ABCDEFG
                               HIJKLMN
                               OPQRSTU
                               VWXYZ-_
Appl 2:EX1 CONDUC  |N_tot:          7
```

☞ Use the **DEL** key to delete erroneous entries or unnecessary characters.

On how to enter names, see also Chapter 6, page 6-24.

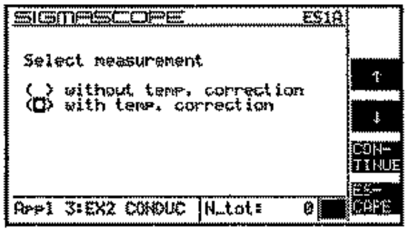
CON-TINUE



```
SIGMASCOPE                         ES1A
 Select measurement
 (●) without temp. correction
 ( ) with temp. correction

Appl 3:EX2 CONDUC  |N_tot:          0
```

No additional parameter selections.

↓

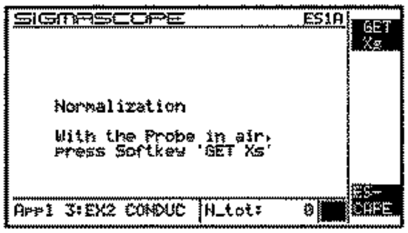


```
SIGMASCOPE                         ES1A
 Select measurement
 ( ) without temp. correction
 (█) with temp. correction

Appl 3:EX2 CONDUC  |N_tot:          0
```

Select 'with temp. correction'.

Normalization

CON-TINUE



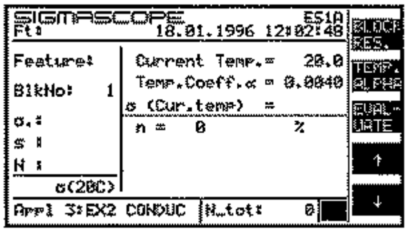
```
SIGMASCOPE                         ES1A

    Normalization

    With the Probe in air,
    press Softkey 'GET Xs'

Appl 3:EX2 CONDUC  |N_tot:          0
```

No additional parameter selections required. Change to the normalization routine.

Hold probe in air and press the softkey **GET Xs**.

The countrate for probe in air will be confirmed.

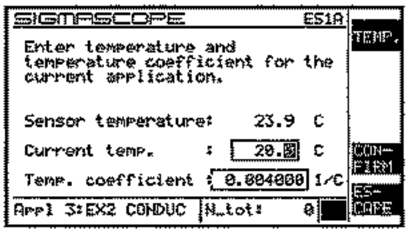
Temperature Compensation



```
SIGMASCOPE                         ES1A
Ft:               18.01.1996 12:02:48
Feature:    | Current Temp.=    20.0
BlkNo:    1 | Temp.Coeff.α = 0.0040
            |σ (Cur.temp)  =
σ.:         | n =   0            %
s :         |
N :         |
     σ(20C) |
Appl 3:EX2 CONDUC  |N_tot:          0
```

Save the new application with its parameters and normalization. Change to the measurement mode of the new application number 3, EX2 CONDUC.

TEMP. ALPHA



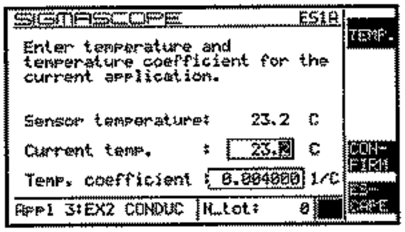
```
SIGMASCOPE                         ES1A
 Enter temperature and
 temperature coefficient for the
 current application.

 Sensor temperature:      23.9  C
 Current temp.      :    20.█   C
 Temp. coefficient  : 0.004000 1/C
Appl 3:EX2 CONDUC  |N_tot:          0
```

Open a menu page to enter the temperature and the temperature coefficient (α) of the material to be measured for Deg. Celsius (°F are also possible, see page 6-61).

Key Selection | **Display** | **Comments**

Temperature Compensation

▼2 3 . ▼2



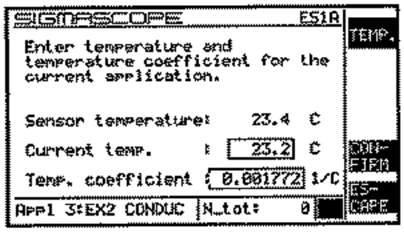
```
SIGMASCOPE                    ES1A
 Enter temperature and
 temperature coefficient for the
 current application.

 Sensor temperature:     23.2  C
 Current temp.      :  [ 23.2] C
 Temp. coefficient  :[0.004000] 1/C
Appl 3:EX2 CONDUC |N_tot:        0
```

Enter the temperature of the specimen.

Measure the temperature with a surface thermometer and enter the reading.

☞ Option:
Connect a surface temperature probe to the MMS® (MULTIFUNCTION socket) and measure the surface temperature of the specimen ("Sensor temperature"). Confirm the "Sensor temperature" as the specimen temperature ("Current temp.") with the softkey TEMP.

ENTER .
0 0
1 7
7 ▼2



```
SIGMASCOPE                    ES1A
 Enter temperature and
 temperature coefficient for the
 current application.

 Sensor temperature:     23.4  C
 Current temp.      :  [ 23.2] C
 Temp. coefficient  :[0.001772] 1/C
Appl 3:EX2 CONDUC |N_tot:        0
```

Enter the temperature coefficient of the material to be measured.

Can usually be looked up in tables or handbooks.

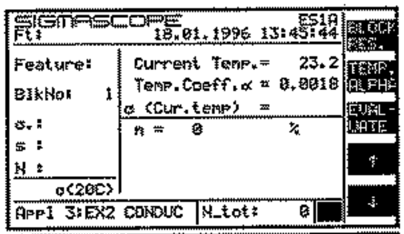
CON-FIRM

Confirm the entries and change to the measurement mode.

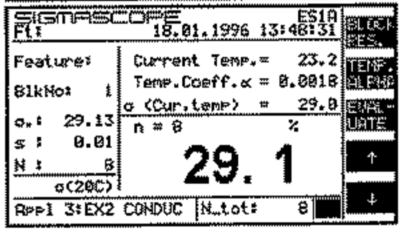
Now, the influence of the temperature will be compensated for during the measurement.

☞ The softkey TEMP. ALPHA opens a window to enter the current temperature and the temperature coefficient of the specimen.

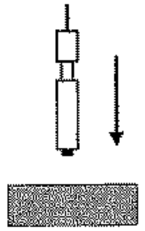
Measurement



```
SIGMASCOPE                  ES1A
Ft:           18.01.1996 13:45:44
Feature:   | Current Temp.=    23.2
BlkNo:   1 | Temp.Coeff.α = 0.0018
           |σ (Cur.temp)  =
σ.:        | n =   0           %
s :        |
N :        |
    σ(20C) |
Appl 3:EX2 CONDUC |N_tot:        0
```



```
SIGMASCOPE                  ES1A
Ft:           18.01.1996 13:48:31
Feature:   | Current Temp.=    23.2
BlkNo:   1 | Temp.Coeff.α = 0.0018
           |σ (Cur.temp)  =    29.0
σ.: 29.13  | n = 8             %
s :  0.01  |
N :      8 |       29.1
    σ(20C) |
Appl 3:EX2 CONDUC |N_tot:        8
```



You are now ready to start the measurement process.

☞ We recommend to make reference measurements prior to the actual measurements to prevent measurement errors. For more detail see Chapter 6, page 6-34.

Example Simple Operating Mode

Switching from standard to simple operating mode.
The following operating mode switch is done in the measurement application of example 3 PERMASCOPE® (📄 Page 4-17).

To make the switch, the standard measurement mode screen must be shown on the display. Call menu function 34 (from the Supervisor Menu). Change the operating mode to 'Simple Measurement Mode'.

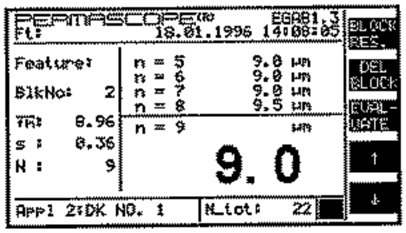
☞ In this simple operating mode, all menu functions called with the **MENU** key are blocked. Functions that can be called directly from the keypad are, however, available.

📄 Further Information about the Simple Operating Mode will you find in Chapter 5, page 5-19.

Measurement application and set up as in example 3 PERMASCOPE®.

Changing to Simple Operating Mode

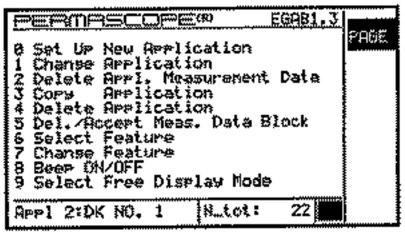
Key Sequence | Display | Comments



```
PERMASCOPE®                    EGAB1.3   BLOCK
Ft:               18.01.1996 14:08:05    RES.
Feature:     n = 5            9.0 µm     DEL
             n = 6            9.0 µm     BLOCK
BlkNo:    2  n = 7            9.0 µm
             n = 8            9.5 µm     EVAL-
₮R:    8.96  n = 9                µm     UATE
s :    0.36
N :       9                9.0           ↑

Appl 2:DK NO. 1       N_tot:     22      ↓
```

Measurement mode screen of the application.

MENU



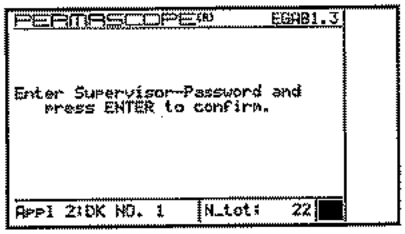
```
PERMASCOPE®                    EGAB1.3   PAGE
0 Set Up New Application
1 Change Application
2 Delete Appl. Measurement Data
3 Copy   Application
4 Delete Application
5 Del./Accept Meas. Data Block
6 Select Feature
7 Change Feature
8 Beep ON/OFF
9 Select Free Display Mode
Appl 2:DK NO. 1       N_tot:     22
```

Calls the menu function screen.

A list with all menu functions is displayed covering several pages.

▼2 **9**

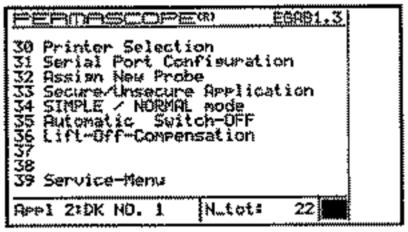
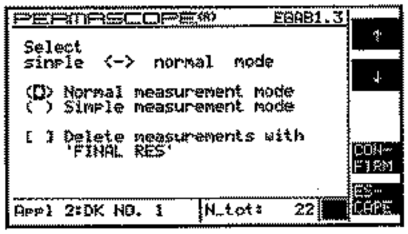
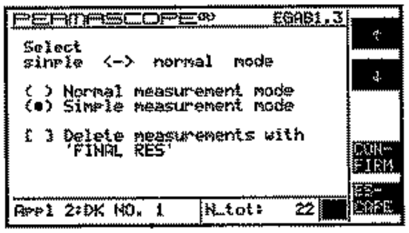
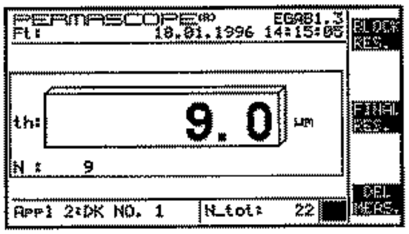
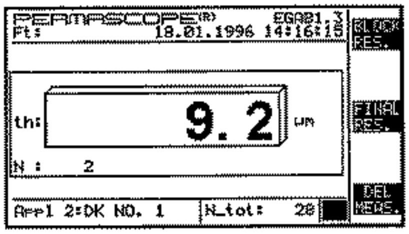
ENTER



```
PERMASCOPE®                    EGAB1.3

Enter Supervisor-Password and
   press ENTER to confirm.

Appl 2:DK NO. 1       N_tot:     22
```

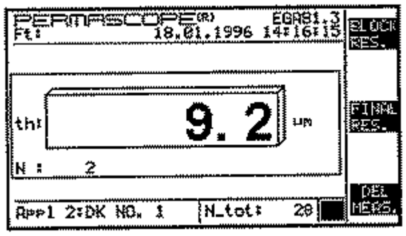
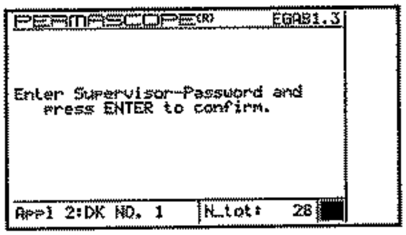
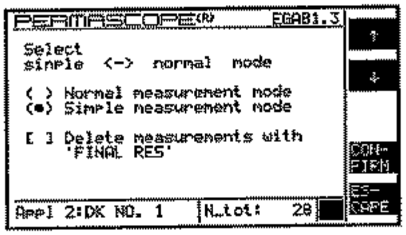
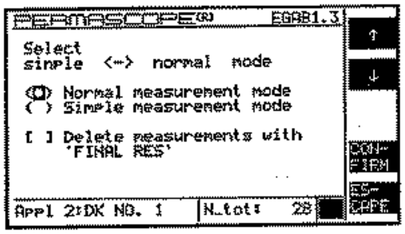
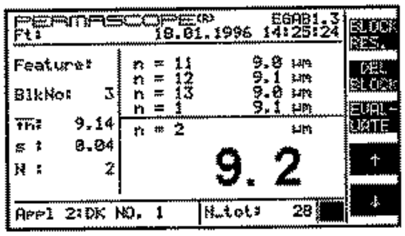
Enter the number 29 to access the Supervisor Menu.

Changing to Simple Operating Mode

Key Sequence	Display	Comments
1 5 9 ENTER	 PERMASCOPE® EGAB1.3 30 Printer Selection 31 Serial Port Configuration 32 Assign New Probe 33 Secure/Unsecure Application 34 SIMPLE / NORMAL mode 35 Automatic Switch-OFF 36 Lift-Off-Compensation 37 38 39 Service-Menu Appl 2:DK NO. 1 N_tot: 22	Enter the supervisor code number 159. The Supervisor Menu with a list of menu functions will be displayed.
3 ◀4 ENTER	 PERMASCOPE® EGAB1.3 Select sinple <-> normal mode (●) Normal measurement mode ( ) Simple measurement mode [ ] Delete measurements with 'FINAL RES' Appl 2:DK NO. 1 N_tot: 22	Enter the number 34 to open the menu function 'Simple/Standard Mode'.
↓	 PERMASCOPE® EGAB1.3 Select sinple <-> normal mode ( ) Normal measurement mode (●) Simple measurement mode [ ] Delete measurements with 'FINAL RES' Appl 2:DK NO. 1 N_tot: 22	Select 'Simple Measurement Mode'.
CON-FIRM	 PERMASCOPE® EGAB1.3 Ft: 18.01.1996 14:15:05 th: 9.0 µm N : 9 Appl 2:DK NO. 1 N_tot: 22	Confirm the selection. The instrument is now in simple operating mode. The simple operating mode screen will be set for the active application.
	 PERMASCOPE® EGAB1.3 Ft: 18.01.1996 14:16:15 th: 9.2 µm N : 2 Appl 2:DK NO. 1 N_tot: 20	Measurements can be made as usual.

Changing from Simple Operating Mode to Standard Operating Mode

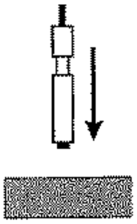
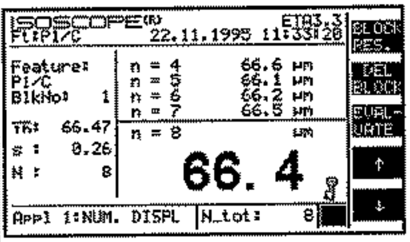
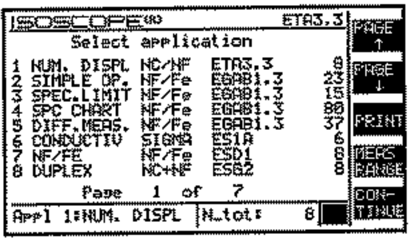
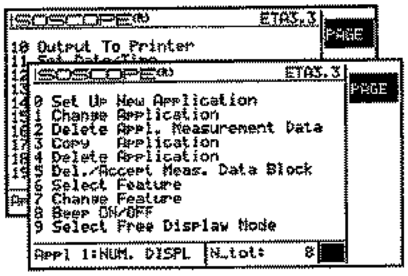
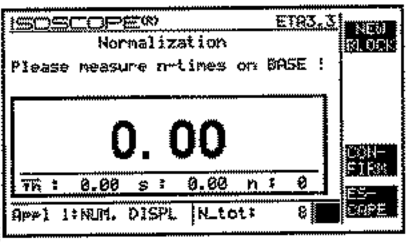
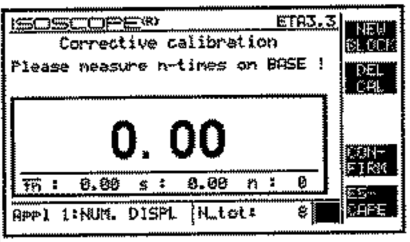
Simple Operating Mode -> Standard Operating Mode

Key Sequence	Display	Comments
	 PERMASCOPE® EGAB1.3 Ft: 18.01.1996 14:16:15 th: 9.2 µm N : 2 Appl 2:DK NO. 1 N_tot: 28 	Simple Operating Mode.
MENU	 PERMASCOPE® EGAB1.3 Enter Supervisor-Password and press ENTER to confirm. Appl 2:DK NO. 1 N_tot: 28	Open the Supervisor Menu.
1 5 9 ENTER	 PERMASCOPE® EGAB1.3 Select simple <-> normal mode ( ) Normal measurement mode (●) Simple measurement mode [ ] Delete measurements with 'FINAL RES' Appl 2:DK NO. 1 N_tot: 28 	Enter the supervisor code number 159. The menu function 'Simple/Standard Mode' will appear.
↑	 PERMASCOPE® EGAB1.3 Select simple <-> normal mode (●) Normal measurement mode ( ) Simple measurement mode [ ] Delete measurements with 'FINAL RES' Appl 2:DK NO. 1 N_tot: 28 	Select 'Standard Measurement Mode'.
CON-FIRM	 PERMASCOPE® EGAB1.3 Ft: 18.01.1996 14:25:24 Feature: BlkNo: 3 Th: 9.14 s : 0.04 N : 2 n = 11 9.0 µm n = 12 9.1 µm n = 13 9.0 µm n = 1 9.1 µm n = 2 µm 9.2 Appl 2:DK NO. 1 N_tot: 28 	Confirm the selection. The instrument is now returned to the standard operating mode. The measurement mode of the current application will be displayed.

☞ **Switching to Simple Operating Mode is is possible for all applications, such as coating thickness, ferrite content, and el. conductivity measurement!**

5 Operation Basics

5.1 MMS® Functional Overview

Action	Display	Description
Measure  Coating thickness, ferrite content el. conductivity **Statistical Evaluation**	 ISOSCOPE® ETA3.3 Ft:P1/C 22.11.1995 11:33:20 Feature: P1/C BlkNo: 1 x̄: 66.47 s : 0.26 N : 8 n = 4 66.6 µm n = 5 66.1 µm n = 6 66.2 µm n = 7 66.5 µm n = 8 µm 66.4 Appl 1:NUM. DISPL N_tot: 8 BLOCK RES. DEL BLOCK EVAL-UATE ↑ ↓	**Measuring** can start immediately after switching the instrument ON. **Statistical Evaluation** can be performed in the measuring mode. Normalization or calibration of the measurement application should be performed in advance.
Applications **Calling** APPL	 ISOSCOPE® ETA3.3 Select application 1 NUM. DISPL NC/NF ETA3.3 8 2 SIMPLE OP. NF/Fe EGAB1.3 23 3 SPEC.LIMIT NF/Fe EGAB1.3 15 4 SPC CHART NF/Fe EGAB1.3 80 5 DIFF.MEAS. NF/Fe EGAB1.3 37 6 CONDUCTIV SIGMA ES1A 6 7 NF/FE NF/Fe ESD1 8 8 DUPLEX NC+NF ESG2 8 Page 1 of 7 Appl 1:NUM. DISPL N_tot: 8 PAGE ↑ PAGE ↓ PRINT MEAS RANGE CON-TINUE	**Application memory** A maximum of 50 application memories is available to store the calibration and measurement parameters, as well as the measurement data of the various applications. The desired application is called through menu selection.
Menu functions MENU	 ISOSCOPE® ETA3.3 10 Output To Printer 11 Set Date/Time ISOSCOPE® ETA3.3 0 Set Up New Application 1 Change Application 2 Delete Appl. Measurement Data 3 Copy Application 4 Delete Application 5 Del./Accept Meas. Data Block 6 Select Feature 7 Change Feature 8 Beep ON/OFF 9 Select Free Display Mode Appl 1:NUM. DISPL N_tot: 8 PAGE	**Menu functions** Use the menu functions to define measurement parameters and instrument configurations, and to edit applications. See Chapter 6 for a description of the menu functions.
Normalization ZERO	 ISOSCOPE® ETA3.3 Normalization Please measure n-times on BASE ! 0.00 x̄ : 0.00 s : 0.00 n : 0 Appl 1:NUM. DISPL N_tot: 8 NEW BLOCK CON-FIRM ES-CAPE	**Normalization** Adjusting the probe characteristic to the instrument and application, equivalent to a "Zero" correction. A normalization is obligatory when an application is defined.
Calibration CAL	 ISOSCOPE® ETA3.3 Corrective calibration Please measure n-times on BASE ! 0.00 x̄ : 0.00 s : 0.00 n : 0 Appl 1:NUM. DISPL N_tot: 8 NEW BLOCK DEL CAL CON-FIRM ES-CAPE	**Calibration** Adjusting the probe characteristic to the attributes of the specimen using one or more calibration standard(s) (geometry, material, etc.)

Application

An application is characterized by the probe type (test method, serial number), by the coating/substrate material combination, and by the geometric configuration, magnetic permeability, electrical conductivity, and the surface roughness of the specimen. If one of these features changes, a new measurement application may be required and the new application must be defined with all its characteristic values. A separate application memory, defined by an application number and an application name, is assigned to each individual application. For each application, the correction data obtained through calibration and normalization, as well as the measurement data and evaluations, are stored in the specific application memory.

Probe

Measurement types see pages 5-11 and 5-19

The correct probe for the application must be connected before defining a new application (🗐 see Chapter 2). The type of measurement (🗐 see Section "Measurement Data Presentation" and "Simple Operating Mode") and the corresponding parameters can be defined for each application (menu function 0 or 1). A normalization or a calibration must be performed for the application when a new application is defined.

☞ **Perform the normalization or calibration carefully - it determines the accuracy of the subsequent measurements. - Please remember, measurements can never be more accurate than the normalization or calibration!**

Two Operating Modes

Depending on the application, operation of the MMS® can be limited to a simple operating mode. Set-up operations in menu functions, such as defining an application, etc. or setting parameters are not available in this so-called 'simple operating mode'. This simple operating mode features only one type of measurement presentation. 🗐 See Chapter 4 (Examples) and Chapter 5, Section "Simple Operating Mode" for further information.

Storage Capacity

An application may contain n single readings or individual blocks (measurement series) each with n measurements. A maximum of 20,000 measurements and 2,000 blocks can be assigned to a total of 50 applications (memories). A summary of occupied and free memory areas can be called through menu function 16 'Instrument Status'. The application set-up and measurement data remain stored in memory, even when the instrument is switched off. Measurement is performed in the measurement mode of the application.

Statistical Evaluation

The statistical evaluation options are called from the measurement mode (using softkey EVAL UATE). The statistical evaluation is performed separately for each application. Within an application, the evaluation can be performed per block or over a selection of x blocks. Different display evaluation modes, such as SPC Chart or Histogram, are available. Microprocessors and sophisticated Software perform the complicated mathematical evaluation; the user receives a evaluation of his measurement with measurement and statistical data.

Display Messages

Wrong

☞ In previously defined applications, measurements must always be performed with the **same probe** that was **used to open the application.** If this probe is **not used**, but only the same probe model, a message "Wrong" will flash in the upper right corner of the display. In this case, measurement, normalization, and calibration are not possible. 🗐 See Chapter 6, Section "32 Assign New Probe", page 6-91.

Missing

☞ If **another probe type** (other test method) is connected to the instrument, the message "Missing" will flash in the upper right corner of the display, instead of the probe type. Measurement, normalization, and calibration are not possible.

equal

☞ If two **probes of the same type** (same test method) are connected to the **PERMASCOPE probe sockets,** the message "equal" will flash in the upper right corner of the display, instead of the probe type. Measurement, normalization, and calibration are not possible.

☞ A measurement with the wrong probe type is not possible.

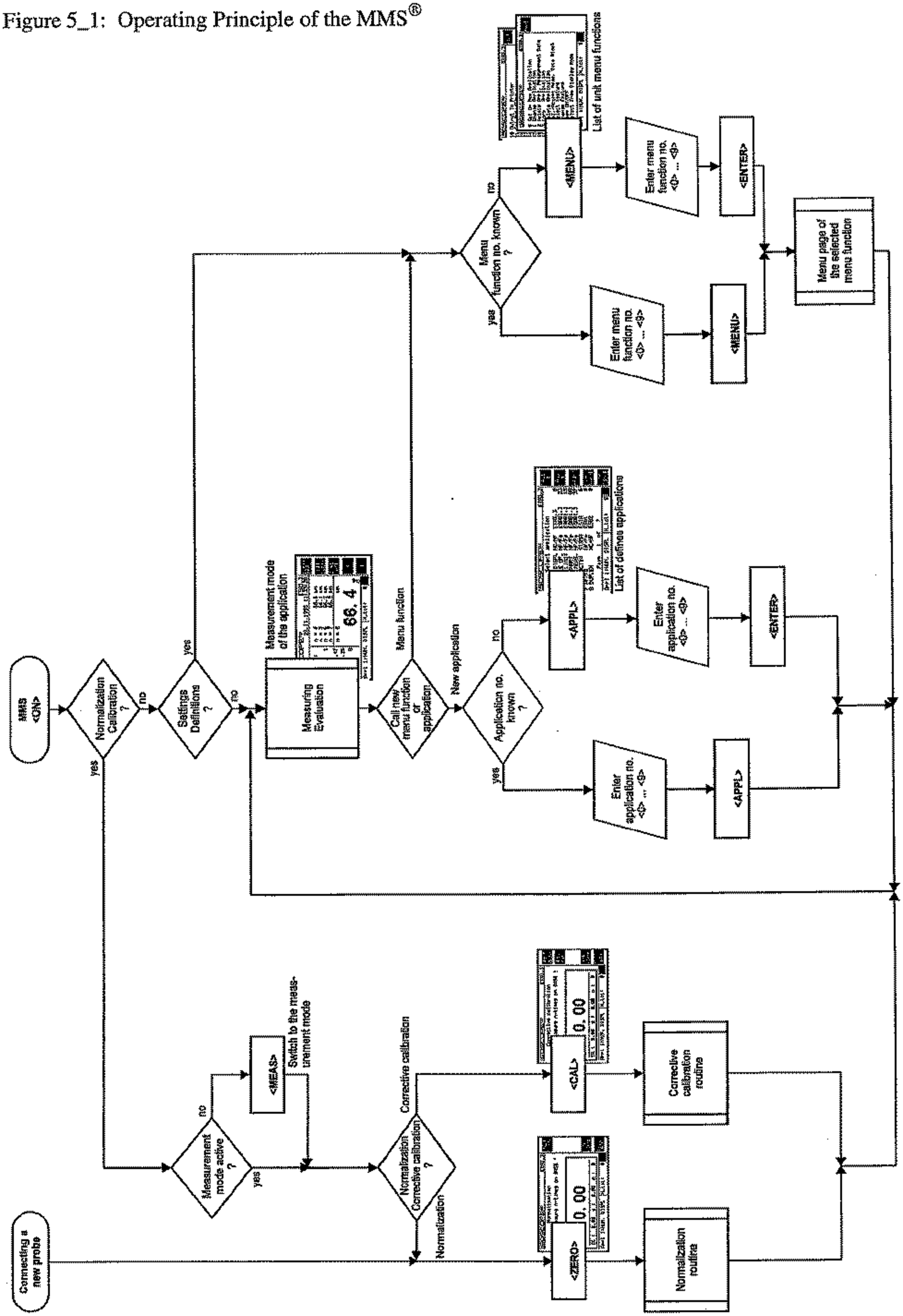
Acoustic Signals

Acoustic Signals

- **For measurement accept**: one short acoustic signal, unless the acoustic signal in menu function 8 is activated.
- **For measurement violating the upper or the lower specification limit**: one short acoustic signal.
- **Outlier**: two short acoustic signal, unless the outlier control is activated (menu function 0 or 1).
- **Outlier and violating the upper specification limit:** only one short acoustic signal (outlier signal in this case the low limit outlier signal will be suppressed).
- **Automatic block result**: one long acoustic signal (not for SPC Chart). A long acoustic signal will sound after each automatically created block.

☞ According to the combination of activated menu functions, the acoustic signals sound immediately one after another.
Example:
If the acoustic signal for indication of measurement accept is enabled, the acoustic signal for violation of specification limits sounds immediately after the measurement accept signal.

Figure 5_1: Operating Principle of the MMS®



5.2 Handling of a Probe

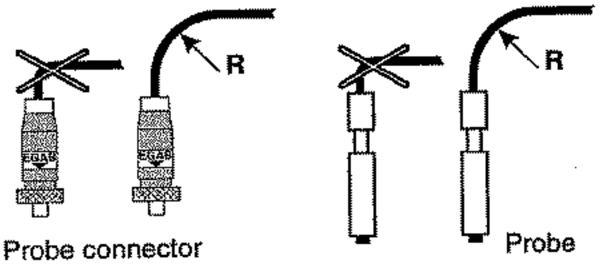
Probe Connection

Instructions to connect probes, printers, etc. can be found in Chapter 3 Start-Up.

Change probes only when the instrument is switched OFF.

In previously defined applications, measurements must always be performed with the probe that was used to define the application. See also Chapter 6, Section "32 Assign New Probe, page 6-91.

Do not bend the probe connector cable! — It may lead to a line break. R ≥ 50 mm, see the following figure.



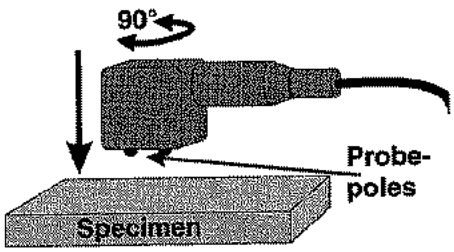
Observe when measuring with probes!

- Always place the probe gently onto the specimen, and perpendicular to the surface.
- Avoid impacting the probe.
- Do not scratch the surface.
- Do not let the probe float above the surface. Doing so leads to erroneous measurements.
- As soon as the probe is lifted off the specimen (min. 50 mm (1.9")), the instrument is ready for the next measurement.

Two-pole Probes

Additional for Two Pole Probes!

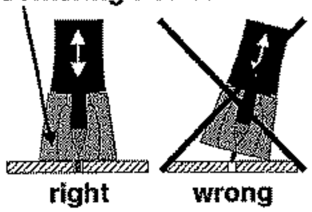
- Rotate two-pole probes by 90° (horizontal to the surface) for each measurement placement on the specimen, to counter possible directional effects of the substrate.
- Check that both poles are in contact with the surface.



- If the probe is not spring-loaded, uniform contact pressure must be applied.
- For cylindrical specimens, place the probe parallel to the longitudinal axis.

Additional for
ESL08A Probe!

Centering Device



Probe ESL08A

- Hold the probe straight and perpendicular to the board while inserting and withdrawing the probe into and from plated through holes.

☝ **Be careful when handling measurement probe ESL08A** - not using proper caution may result in damage to the probe tip.

☞ **The centering device** aids in safe insertion of the probe tip into the plated through hole and at the same time protects the probe tip from mechanical damage. The centering device attaches to the probe.

☞ **Please do not use force** if the probe tip binds due to tilting while removing the probe from the plated through hole. Carefully push the probe back into the hole and try again to remove it straight.

☞ Using force when inserting or removing the probe may destroy the probe. Fischer cannot accept warranty claims for damage due to improper handling.

☞ Do not try to straighten bent probe tips. Doing so inevitably will break off the probe tip. Instead, if mechanically feasible, continue to measure with the bent probe tip. This does not influence the measurement accuracy.

Observe when measuring with
Beta Probes!

Beta Probes

- Please see the instructions under "Platens, Sources, and Standards", before working with beta probes.
- Helpful hints to select a suitable isotope can be found in Table 8_2 of Chapter 8.
- For highest measurement accuracy, the opening of the aperture platen should be selected as large as possible, yet small enough to avoid placement errors.
- The detector (counter tube) needs approx. 15 minutes prior to the measurement to reach operating temperature.
  Connect the Beta probe or measuring table to the MMS®, place the substrate on the probe (or the probe on the substrate, depending on the measuring table, or whether a hand probe is used), switch the MMS® ON and wait a minimum of 15 minutes. After this period, the detector is at operating temperature.

5.3 Measurement Preparation

5.3.1 Menu Function Settings

Depending on the menu function, desired settings or definitions that deviate from the default settings should and in some cases must be made before making measurements or before defining an application.

See Chapter 6, Section "Description of the Menu Functions" for more information about the individual menu functions.

General Settings

General Settings

In general, these settings are defined only once during initial start-up of the instrument.

Menu Function	Description	Default Setting Depending on country of delivery
8 Beep ON/OFF	**Switch audible signal for measurement capture ON/OFF**	audible signal ON
10 Output to Printer	**Type of measurement data output to printer**	print single readings
13 Output to Serial Port	**Type of measurement data output to RS232 interface**	single reading without separator
11 Set Date/Time	**Set the display format for date and time,** **set the current date and time**	Format: European / USA current date/time
12 Select Units	**Set the units of measurement**	coating thickness: Inch Units el. conductivity: % IACS temperature: Fahrenheit ferrite content: WRC-FN
17 Adjust Brightness	**Adjust display brightness and contrast**	no fixed settings
19 Display Resolution	**Display resolution**	0.99 / 9.9 / 99.9 / 999 / 9999
29 Supervisor Menu + 30 Printer Selection	**Define printer type**	9-pin dot matrix printer

Settings before/ during Application Definition

Settings that should be defined before/during the definition of the application

The type of measurement data display can be stored specifically for each application.

Menu Function	Description	Default Setting
18 Disp. Mode/ Meas. Trigger	**Define the measurement data display type and capture mode**	Measurement display: th Measurement capture: probe sig. + ext. start (not applicable for BETA)
0 Set Up Application	**Define display mode,** **Tmeas** (only BETA) **Measurement data display after i measurements, " i individual value:"** **Outlier control,** **Limit monitoring,** **Print automatic evaluation,** **n blocks per evaluation,** **Automatic batch result,** **n measurements per block,** **Offset** (not for BETA), **Print form selection,** **Application name**	numeric display 5 1 not active not active, upper/lower limits depending on range of probe not active 1 not active 5 0.00 standard report for block result and final result Appl. No. x
15 Enter Density (only for BETA)	**Correction the density variations of the coating material**	1
Probe Connection		

☞ **In menu 18,** setting measurement display mode (menu page 1) affects the active application only while setting measurement trigger mode (menu page 2) is an instrument global setting and affects all applications.

☞ **BETA:** Menu 15 can be called only when there are no measurement data in the application (empty application).

Settings that must be defined before making measurements

Settings Before Making Measurements

A feature can be assigned to each block (measurement series within an application).

Menu Function	Description	Default Setting
6 Select Feature	**Assign a feature to a new block (measurement series)**	no definition

☞ Features can be defined from menu function 7 'Edit Feature'.

5.3.2 Avoiding Measurement Errors

☞ Keep the measurement area free of dirt, oil and grease.

☞ **Be careful during calibration/normalization! It determines the accuracy of the subsequent measurements. - Measurements can never be more accurate than the calibration/normalization itself!**

☞ Check the calibration/normalization by performing a reference measurement. A corrective or master calibration must be performed, if the results of the reference measurement are not within pre-defined specification limits.

For greater detail see Chapter 7.

☞ For the magnetic induction test method, a calibration through the coating can be performed if an uncoated specimen is not available for the normalization or calibration. For greater detail see Chapter 7.

5.3.3 Settings for Copper Plating Thickness Measurements in PC-board Plated Through Holes

Prior to making measurements in PC-board plated through holes, the following parameters must be set or checked.

- **PC-board Thickness**
  The thickness of the PC-board to be measured must be entered in menu function 20. The entry refers to the active application only. The default setting is 1.5 mm (62 mils).
  See Chapter 6, page 6-75 for a description of menu function 20.
  See also Chapter 8, Section "Measurement of the Cu Plating Thickness in PC-board Plated through Holes" beginning at page 8-2.
- **Correction Factor**
  A correction factor can be entered in menu function 21. During measurement, this factor takes into account differences in electrical conductivity and temperature in comparison to the corrective calibration. The entry refers to the active application only. The default setting is 100 %.
  See Chapter 6, page 6-79 for a description of menu function 21.
  See also Chapter 8, Section "Measurement of the Cu Plating Thickness in PC-board Plated through Holes" beginning at page 8-2.
- **Probe Sensitivity**
  For probe ESL08A, the sensitivity of measurement acquisition can be entered in menu function 22 to avoid erroneous measurements. This is a factor depending on the through hole diameter and the coating thickness to be measured.
  See Chapter 6, page 6-82 for a description of menu function 22.

5.4 Measurement Data Presentation

The FISCHERSCOPE® MMS® offers 3 types of measurement data presentation:

- Numeric Display
- Specification Limit Display
- SPC Chart

☞ The following Sections describe these types of measurement data presentations in greater detail. The corresponding examples can be found in Chapter 4, Section "Examples".

The MMS® measurement system offers the ability to limit operation:

- simple operating mode

This simple operating mode has its own type measurement data presentation.

Beginning at page 5-19 features a more detailed description of this simple operating mode.

In a special version, the MMS® measurement system offers additional the following measurement application for coating thickness measurement using the measuring types PERMASCOPE® and ISOSCOPE®:

- Difference Measurement

The difference measurement is designed for a special up to 4-coating measurement application.

For a more detailed description of the Difference Measurement see page 5-21.

A corresponding example can be found in Chapter 4, Example 7.

5.4.1 Numeric Display

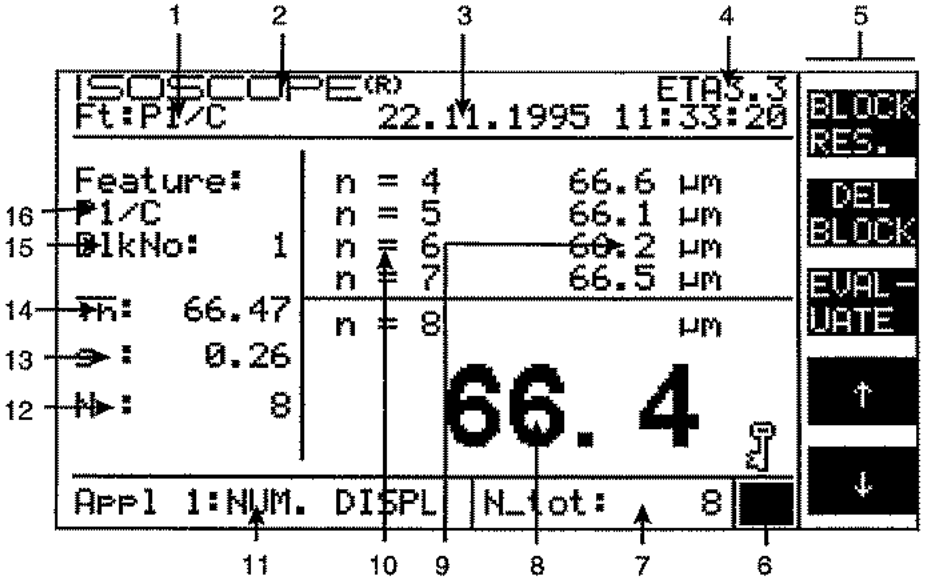
With this type of measurement data presentation, the measurement is displayed on the screen directly in the respective unit, e.g., µm (mils), (unless Xn or X has been set in menu function 18).

Standard Setting

Other types of measurement data presentations can be set when defining or editing an application (▤ see following Sections).

Description of the Display

Description of the Displays (Measurement Mode)



1 Current feature

2 measuring type, ISOSCOPE® = eddy current test method

3 Date and Time

4 Probe model

5 Softkey functions

- BLOCK RES. Block result: Closure and statistical evaluation of a block
- DEL BLOCK Delete the last open block (for BETA: the softkey function DEL BLOCK is replaced by the START function)
- EVAL-UATE Change to the evaluation menu
- ↑, ↓ Scroll through the single readings

6 Entry box for menu function and application numbers

7 Sum of all single readings (or "mean values") of an application

8 Current measurement

9 Measurement data of a measurement series/block

10 Consecutive numbering of the single readings

11 Number and name of the current application

12 Number of the single readings of a block (e. g. of block no. 1)

13 Standard deviation of the block

14 Mean value (of a block)

15 Current block number

16 Feature of the current block

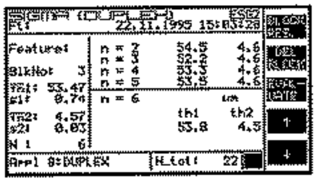
☞ **Numeric Display is the default setting** of the instrument and need not be selected initially.

☞ The change from numeric display to specification limit display is carried out easily using menu function 1, 'Change Application'.

☞ **When changing** measurement data presentation from **SPC Chart or Difference Measurement** to Numeric Display, all measurement data of this application will be deleted!

☞ A key in the numeric display indicates **the end of each block**.

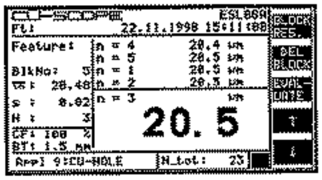
☞ **For Duplex coating measurements**, both coating thicknesses are shown on the display. Description:
$\overline{th}1$: Coating thickness of the paint coating (non-conductive coating, top coating).
$\overline{th}2$: Coating thickness of the zinc coating (NF coating, coating between substrate and paint coating).



```
SIGMA (DUPLEX)                    ESG2
Ft:               22.11.1995 15:03:28
Feature:      n = 2      54.5     4.6
              n = 3      52.2     4.6
BlkNo:     3  n = 4      53.3     4.6
              n = 5      53.5     4.6
x̄1:  53.47   n = 6              µm
s1:   0.74
                          th1     th2
x̄2:   4.57                53.8    4.3
s2:   0.03
N :      6
Appl 8:DUPLEX      N_tot:   22
```

Numeric Display for the duplex coating measurement

☞ **For measurement in PC-board plated through holes,** the display also shows the board thickness (BT) and correction factor (CF). Example: BT: 1.5 mm (62 mils), CF = 100 %.



```
CU-SCOPE                          ESL080
Ft:               22.11.1998 15:11:08
Feature:      n = 4         20.4 µm
              n = 5         20.5 µm
BlkNo:     5  n = 1         20.5 µm
x̄ :  20.48   n = 2         20.5 µm
s :   0.02   n = 3              µm
N :      3
CF: 100    %        20.5
BT: 1.5 mm
Appl 9:CU-HOLE     N_tot:   23
```

Numeric Display for the measurements in PC-board plated through holes

📄 You will find a description of the Softkeys in Chapter 6.

📄 See Chapter 6, Sections "Short-Form Instruction: Instrument Operation" and "Description of the Menu Functions" for instructions on how to call the different menu functions.

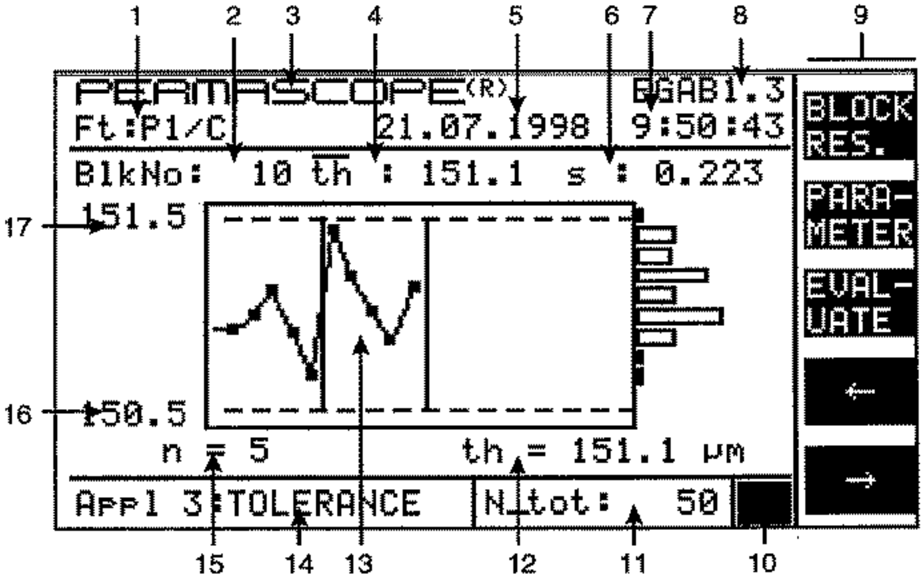
📄 Various examples can be found in Chapter 4.

5.4.2 Specification Limit Display

In this measurement data presentation mode, the measurements are displayed graphically. The display shows if the measurement is within the specification limits and its location within these limits, in addition to the display of the measurement, for instance in µm.

Description of the Display

Description of the Display (Measurement Mode)

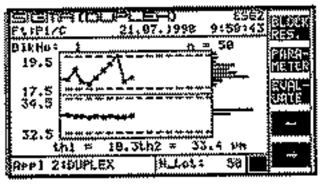


1 Current feature
2 Current block number
3 measuring type, PERMASCOPE® = magnetic induction test method
4 Mean value (of a block)
5 Date
6 Standard deviation of the block
7 Time
8 Probe model
9 Softkey functions
  - BLOCK RES. Block result: Closure and statistical evaluation of a block
  - DEL BLOCK Delete the last open block (for BETA: the softkey function DEL BLOCK is replaced by the START function)
  - EVAL-UATE Change to the evaluation menu
  - ←, → Scroll through the single readings
10 Entry box for menu function and application numbers
11 Sum of all single readings (or "mean values") of an application.
12 Current measurement
13 Graphical display of the measurement data
14 Number and name of the current application
15 Number of measurements per block
16 Lower specification limit
17 Upper specification limit

☝ Existing measurement series/measurement data of applications in measurement data presentations SPC Chart or Difference Measurement are **deleted when changing to specification limit display.**

Applications with **Numeric Display** can be changed to **Specification Limit Display, at any time.**

For Duplex coating measurements, both coating thicknesses are shown on the display. Description:
$\overline{\text{th}}1$: Coating thickness of the paint coating (non-conductive coating, top coating).
$\overline{\text{th}}2$: Coating thickness of the zinc coating (NF coating, coating between substrate and paint coating).



Specification Limit Display for the duplex coating measurement

You will find a description of the softkeys in Chapter 6.

See Chapter 6, Sections "Short-Form Instruction: Instrument Operation" and "Description of the Menu Functions" for instructions on how to call the different menu functions.

Various examples can be found in Chapter 4.

Description of the Specification Limit Display

Description Specification Limit Display

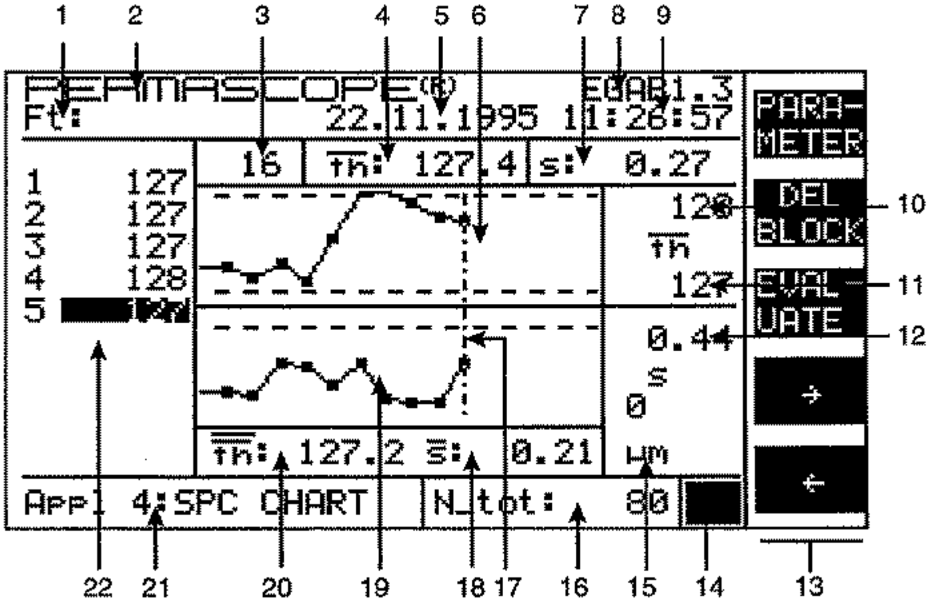
Specification limit display offers the possibility for process control. The measurement data distribution is clearly visible due to the graphical display. In this measurement data presentation, the respective multifunction outputs (TTL) are active for upper and lower limit violations and for measurements within the specification limits. Signal lights or relays can be controlled with these outputs (See Chapter 3, Start-Up).

5.4.3 SPC Chart

With this type of measurement data presentation, measurements can be clearly displayed for process control. The measurement data of the random samples of a process are displayed according to the method of statistical process control ($\overline{X}$-Chart/s-Chart or $\overline{X}$-Chart/R-Chart).

Description of the Display

Description of the Display (Measurement Mode)



1 Feature of the block

2 measuring type, PERMASCOPE® = magnetic induction test method

3 Block number = Number of random samples

4 Mean value of the random sample

5 Date

6 Mean value chart ($\overline{\text{th}}$)

7 Range (R) or Standard deviation (s) of the random sample

8 Probe model

9 Time

10 Upper control limit

11 Lower control limit

12 Upper control limit of the range (R) or the standard deviation (s)

13 Softkey functions

- **PARA-METER** Entry/Selection of the SPC Parameter
- **DEL BLOCK** Delete last open block (for BETA: the softkey function DEL BLOCK is replaced by the START function)
- **EVAL UATE** Change to the Evaluation menu
- ←, → Scroll through the single readings

14 Entry box for menu function and application numbers

15 Unit of measurement

16 Sum of all single readings of the application

17 Block marking

18 Mean range ($\overline{R}$) or mean standard deviation ($\overline{s}$) of all random samples (blocks)

19 Range or standard deviation chart

20 Mean value of all random samples (blocks)

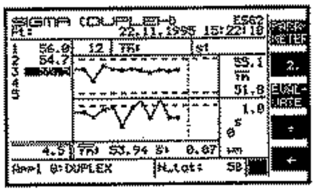
21 Number and name of the current application

22 Measurement data of the random samples (of a block)

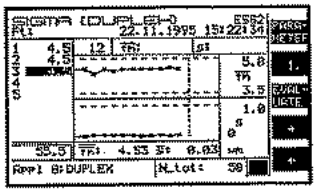
☝ **You must set SPC Chart Display** for an application **prior to the first measurement!** Existing measurement series of an application will be deleted when changing the presentation type (e.g., from Numeric Display to SPC Chart Display)!

☞ When outlier monitoring is active, an '**Outlier**' is marked with a "!". It will not enter the statistical evaluation. See also Chapter Appendix B, page 6-46.

☞ **For Duplex coating measurements**, both coating thicknesses are displayed on two menu pages. Description:
th1: Coating thickness of the paint coating (non-conductive coating, top coating).
th2: Coating thickness of the zinc coating (NF coating, coating between substrate and paint coating).
Use softkeys **1.** and **2.** to switch between the menu pages.



Top coating



NF coating (e.g., Zinc)

SPC Chart Display for the duplex coating measurement

You will find a description of the softkeys in Chapter 6.

See Chapter 6, Sections "Short-Form Instruction: Instrument Operation" and "Description of the Menu Functions" for instructions on how to call the different menu functions and for an overview.

Various examples can be found in Chapter 4.

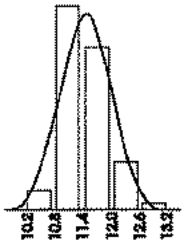
Description SPC Chart

Description of the SPC Chart Display

Systematic and random influences on the production process can be shown with this method of statistical process control. Processes can be controlled based on these evaluations. An extensive statistical evaluation presented as a list on two menu pages can be opened.

For process control, random samples (subgroups) are taken from a production process in equal time intervals (if possible). The random sample consists of a number (subgroups) of production parts. Only one measurement is needed for each part. For each random sample, made up of, for instance, of 5 parts, the mean value and, depending on the setting, the range or standard deviation are displayed in a plot (x-bar, R or x-bar, s chart). This parameter arrangement, e.g., mean value of the coating thickness and the range, show if the process is within preset limits, the control limits (UCL, LCL). Systematic influences become apparent if these limits are violated. The responsible departments must then determine the nature of the influences and correct the problem.
Trends of the process can thus be seen from the mean value plot. The plots of the range or standard deviation (depending on the setting) reveal production fluctuations of the group (random sample).

Prerequisites for Statistical Process Control



Normal Distribution

Applying the method of statistical process control assumes normal distribution. For a process, this means:

- low and equal distribution around the mean value,
- equal distance of the mean value to the pre-set specification limits.

Therefore, it is useful to check the frequency distribution (Histogram) after several subgroup measurements. To do this, the MMS® offers a respective function in the statistical evaluation menu (EVAL UATE) using the softkey HISTO GRAM.

Hints for Interpreting the Graphical Display

A point of the plot that violates the control limits is generally a sign that the distribution, and thus the process, has worsened, or that the measurement system has changed (e.g., a different operator).

Range/Standard Deviation Chart

Continuously rising points of the plot, or points that are above the limits of the standard deviation, indicate a larger spread in the production or a change in the measurement system (e.g., a different operator). Continuously declining points of the plot, or points that are below Zero, point to a lesser spread or to a change in the measurement system that conceals the actual process quality. In general, $^2/_3$ of the plot should be in the central third of the control limit range. Check whether the limits have been set properly or whether the subgroup includes measurement data of two or more production lines, if significantly fewer than $^2/_3$ of all points of the plot are close to the range or standard deviation limits.

In general, the control limits are corrected or recalculated, if a systematic influence is identified and corrected, or if the process has shifted. Then, process control can continue, usually with narrower limits.

☞ The corrected control limits should be saved in a new application. A long-term overview of the process may be of interest in the future. As a minimum, the process with the 'old' control limits should be printed out and archived.

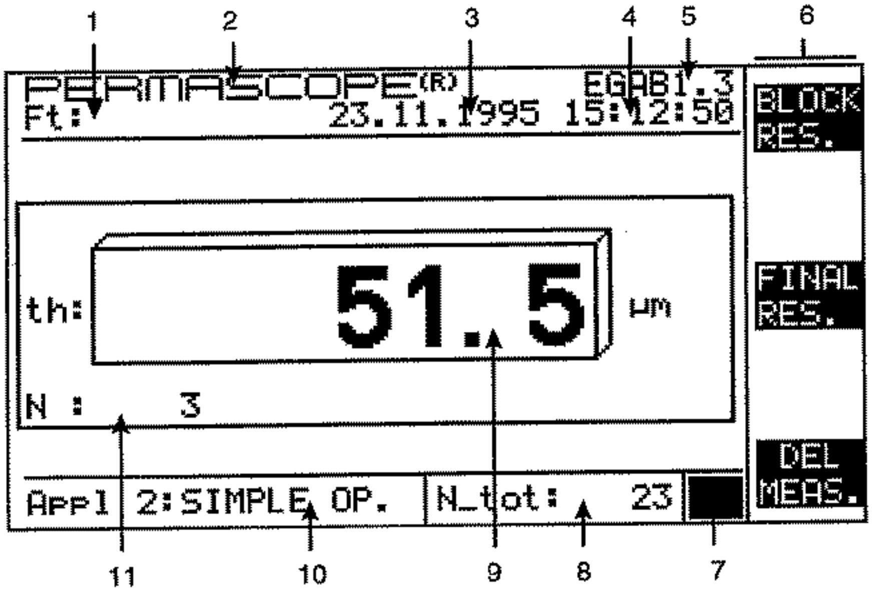
☞ From the statistical evaluation menu, it is possible to select the subgroup of interest (e.g., subgroups. 10 to 16) and conduct the respective evaluation for the selected subgroup range. This allows for more precise statements about a certain period of the process that can serve to correct systematic influences.

5.5 Simple Operating Mode

The simple operating mode has its own measurement data presentation mode allowing for immediate recognition of this operating mode.

Description of the Display

Description of the Display



1 Feature of the blocks

2 measuring type, PERMASCOPE® = magnetic induction test method

3 Date

4 Time

5 Probe model

6 Softkey functions

   BLOCK RES. Block Result: Closure and statistical evaluation of a block

   FINAL RES. Statistical evaluation of all blocks

   DEL MEAS. Delete all measurement data of the current application

7 Entry box for the application numbers

8 Sum of all single readings of the application

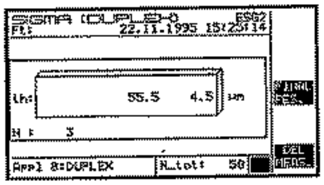
9 Currently measured (latest) measurement

10 Number and name of the current application

11 Number of single readings of a block

☞ If the simple operating mode is selected, all other applications will automatically appear in the simple operating mode as well.
Exception: Applications with difference measurement cannot be displayed in this mode.

☞ **For Duplex coating measurements,** both coating thicknesses are shown on the display. Description:
Left value: Coating thickness of the paint coating (non-conductive coating, top coating).
Right value: Coating thickness of the zinc coating (NF coating, coating between substrate and paint coating).



Simple Mode for duplex coating measurement

An example on how to switch the simple operating mode ON or OFF can be found in Chapter 4.

See Chapter 6, for instructions on how to call menu function 34 'Simple/Normal Mode', page 6-95.

Description Simple Operating Mode

Description of the Simple Operating Mode

Operation of the instrument can be simple. No settings in the menu functions, such as defining an application, etc. and defining/changing parameters are possible in this so-called 'simple operating mode'. Measurements can only be made according to the settings of previously created applications.

Keypad

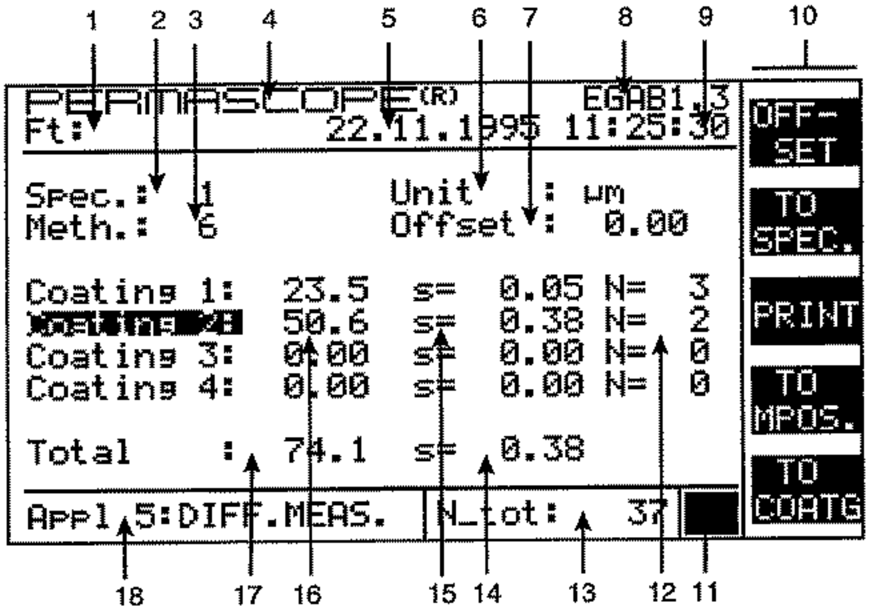
Functions of the keypad are still available in the simple operating mode. Only the MENU key no longer offers its normal function. It directly opens the Supervisor Menu. Access to menu function 34 'Simple/Normal Mode' is available by entering the Supervisor code.
See Chapter 6 for a description of menu function 34 'Simple/Normal Mode', page 6-95.

5.6 Difference Measurement (special MMS® version)

In this measurement mode, measurement data for up to 4 coatings are displayed on the screen. See the next page for a description of the measurement application that this measurement mode is based on.

Description of the Display

Description of the Display (Measurement Mode)



```
PERMASCOPE(R)              EGAB1.3
Ft:         22.11.1995 11:25:30

Spec.:  1          Unit   : µm
Meth.:  6          Offset :  0.00

Coating 1:   23.5   s=  0.05  N=  3
Coating 2:   50.6   s=  0.38  N=  2
Coating 3:   0.00   s=  0.00  N=  0
Coating 4:   0.00   s=  0.00  N=  0

Total     :  74.1   s=  0.38

Appl 5:DIFF.MEAS.   N_tot:      37
```

1 Current feature

2 Test Sample number = consecutively numbered specimen

3 Numbered measurement location on the specimen

4 measuring type, PERMASCOPE® = magnetic induction test method

5 Date

6 Unit of measurement

7 User-specific Offset (correction value)

8 Probe model

9 Time

10 Softkey functions

- OFF-SET Open the box for setting the offset value
- TO SPEC. Change to the next sample
- PRINT Change to the Print menu
- TO MPOS. Change to the next measurement location of the specimen
- TO COATG Change to the next coating

11 Entry box for the menu function and application numbers

12 Number of measurements per coating and measurement location

13 Sum of all single readings of an application

14 Standard deviation of the total thickness of all coatings measured (sum total of coatings 1 through 4)

15 Standard deviation of the individual coating

16 Thickness mean value per coating

17 Total thickness of all coatings measured (mean value)

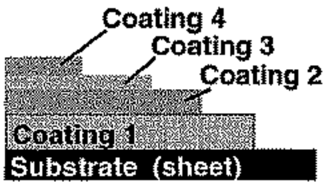
18 Number and name of the current application

☝ **Difference measurement must be set <u>prior</u> to the first measurement** of an application! An existing measurement series of an application will be deleted when changing the presentation mode (e.g., from Numeric Display to Difference Measurement)!

☞ An **Offset** can be entered, even after the measurement. The instrument will then correct the measurement data of all specimen and measurement locations of the application accordingly.

☞ Difference Measurement is **only** available **for the PERMASCOPE® and ISOSCOPE® measuring types.**

Description Difference Measurement



Description of the Difference Measurement

A maximum of 4 consecutive coating thicknesses can be measured as long as each coating is accessible for making a measurement. This means, the paint coatings must be arranged in steps (as shown in the Figure to the side). Each coating of this measurement structure contains several pre-defined measurement locations. A pre-defined number of measurements is carried out at each measurement location. The thicknesses of coatings 2, 3 and 4 are calculated from differences. At each step, the total thickness is measured and the coating thickness of the coating underneath deducted. Example: Thickness of coating 3 = total thickness of coatings 1 through 3 minus the total thickness of coatings 1 through 2. The mean value, standard deviation, and the number of single readings are displayed for each measurement location, and the total thickness of all 4 coatings with the standard deviation.

Offset

An Offset value (correction value, coating thickness in µm or mils) may need to be entered, if the substrate has already been treated and covered with a coating. However, this coating thickness must be known.

6 Instrument Functions

The functions of the FISCHERSCOPE® MMS® measurement system can be called directly using the keypad, or from a selection menu.

Structure of this Chapter:

Section 6.1: Short-form instruction: Instrument Operation
Section 6.2: Description of the Softkeys
Section 6.3: Description of the menu functions that can be called with the MENU key.

6.1 Short-Form Instruction: Instrument Operation

Operation follows the same structure for all applications (measuring types) and data presentation modes. Applications and menu functions are always called in the same manner. The same applies to the normalization and calibration functions.

The following sections offer selections of operating sequences.

Operating instructions for the menu functions are also found in Section 6.3.

Function Overview

MENU

Overview Page

Function Overview
(continued)

MENU

6.1.1 Setting Up an Application

☞ **A measurement** can only be made in an established application!

☞ All parameters of a measurement application (characteristic, correction factors, etc.) are stored in an **Application.** An application is characterized by a number and a name selected or determined by you.

☞ The **name of the application** can have a maximum of 10 characters.

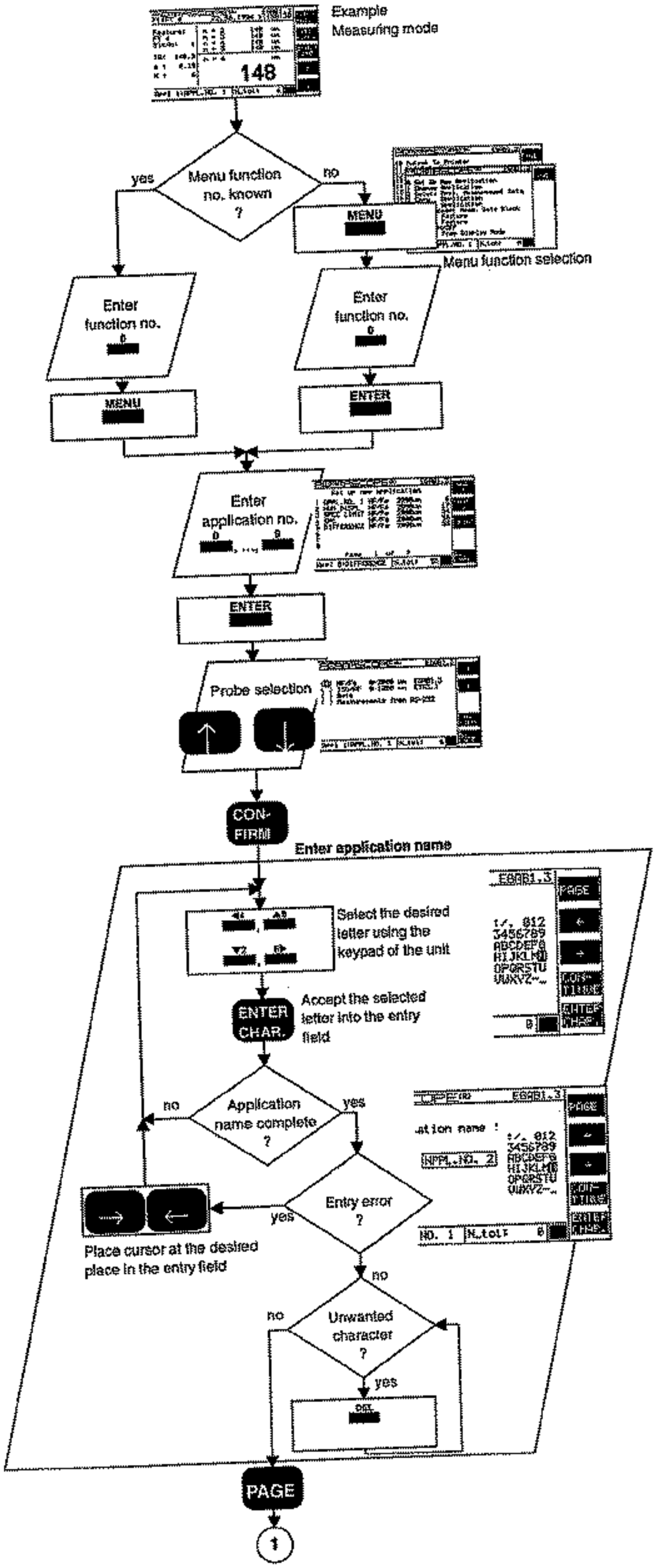
☞ Menu functions and **Applications** can be **called** from the active normalization and calibration functions with the MENU and APPL keys.

☞ Applications for probes cannot be set up if the probes connected to the **PERMASCOPE® sockets** receptables are for the same type of test method (magnetic induction, eddy current, etc.). Disconnect one of the probes to set up an application.
🗎 See also Chapter 3, Connecting a Probe, page 3-1, and Chapter 6, "Display Messages", page 6-32.

Setting Up a New Application follows the same principle in all Applications:

See flow diagram on the next page.

🗎 For examples on how to set up an application see Chapter 4, Section "Examples".



Setting Up an Application

MENU **0** **ENTER**

or

0 **MENU**

☞ A list with all in the instrument previously created applications appears. All numbers not used are available for new applications.

☞ The probe list contains the coating/substrate material combination (or the coatings for multi-coating measurements), the measuring range and the name of the probe model (e.g., NF/Fe 0-2000 µm (0-80 mils) EGAB1.3).

On how to enter the name of an application see also the Section 'Entering Alphanumeric Characters', Page 6-24.

PERMASCOPE®
ISOSCOPE®
DUALSCOPE®
SIGMA
CU-SCOPE
NICKELSCOPE®
FERITSCOPE®
SIGMASCOPE®
FISCHERSCOPE®

Setting Up an Application
(continued)

☞ Use the PAGE softkey to scroll through the menu pages to enter/select all the required settings.

See also pages 6-24 to 6-27.

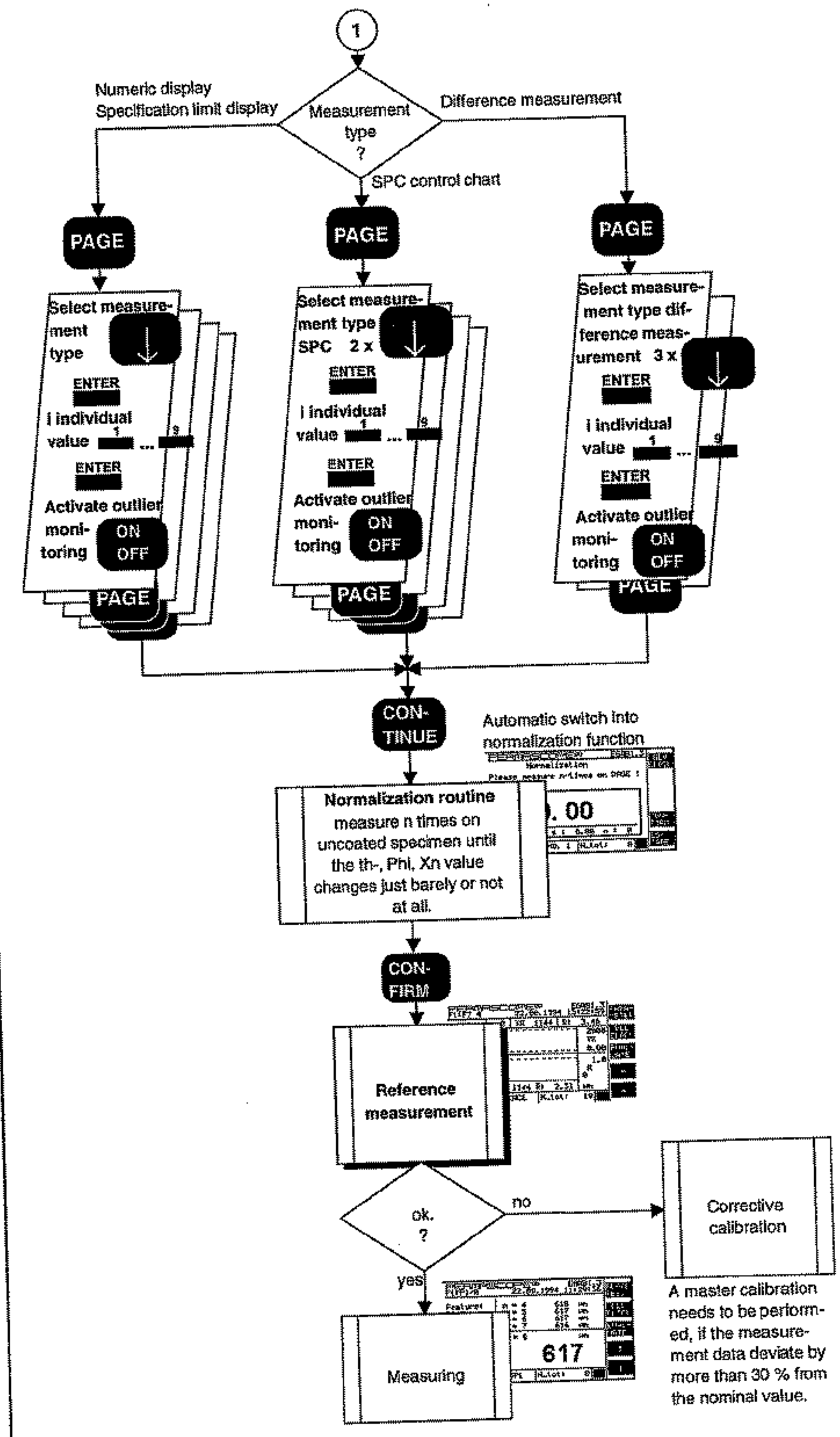
☞ You can quit parameter entry and switch to the normalization function from each menu page using the CON-TINUE softkey .

For a description of the parameters see Appendix B.

☞ We recommend making a reference measurement to avoid measurement errors.

See Section "Reference Measurement" on Page 6-34.

... for coating thickness measurements (excluding Beta), ... for el. conductivity and ferrite content measurements

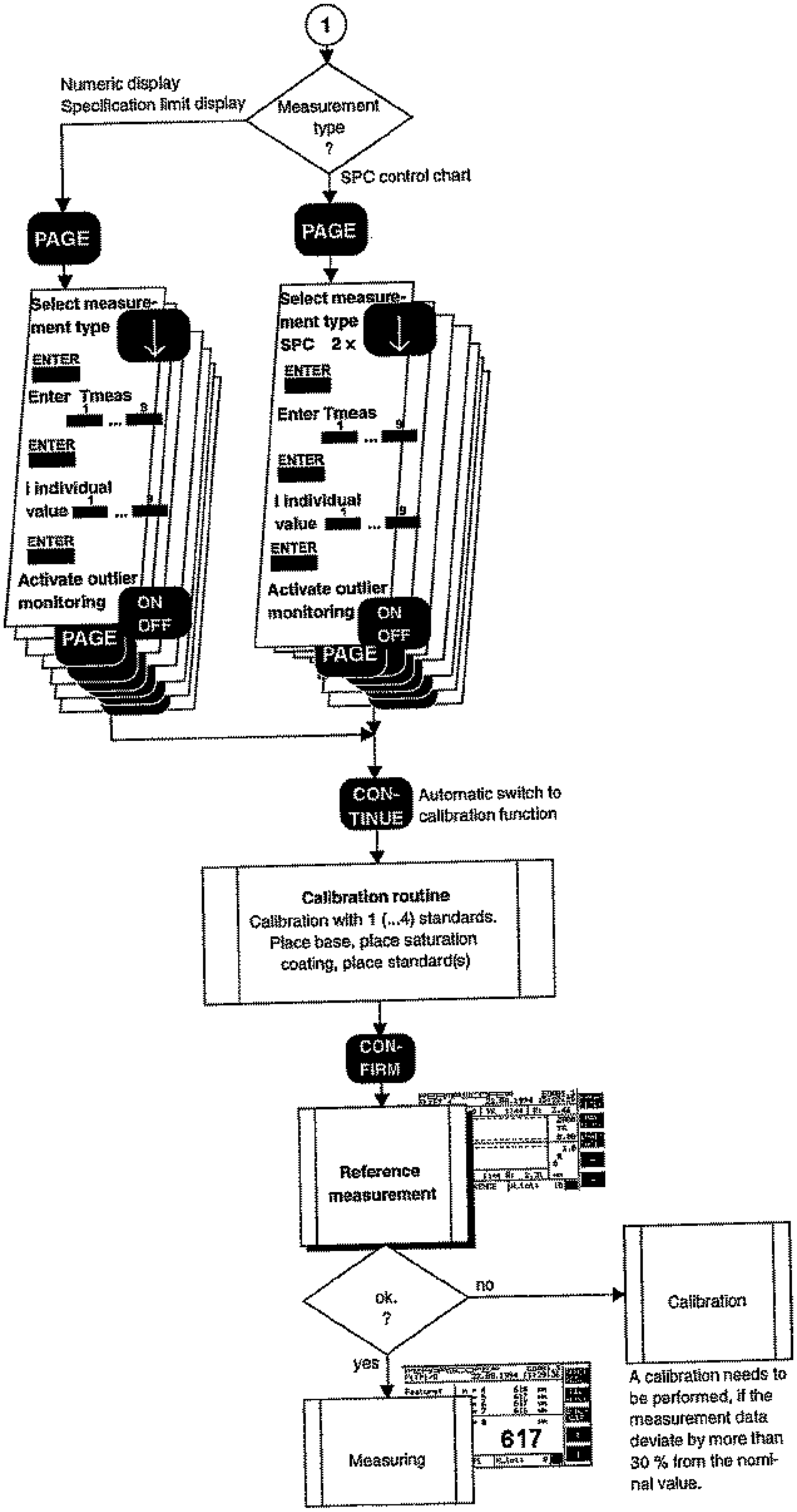


A master calibration needs to be performed, if the measurement data deviate by more than 30 % from the nominal value.

... for coating thickness measurement with Beta probes

BETA

Setting Up an Application
(continued)



A calibration needs to be performed, if the measurement data deviate by more than 30 % from the nominal value.

Use the PAGE softkey to scroll through the menu pages to make all the required settings.

See also pages 6-24 to 6-27.

You can quit parameter entry and switch to the normalization function from each menu page using the CON-TINUE softkey.

For a description of the parameters see Appendix B.

We recommend making a reference measurement to avoid measurement errors

See Section "Reference Measurement" on Page 6-34.

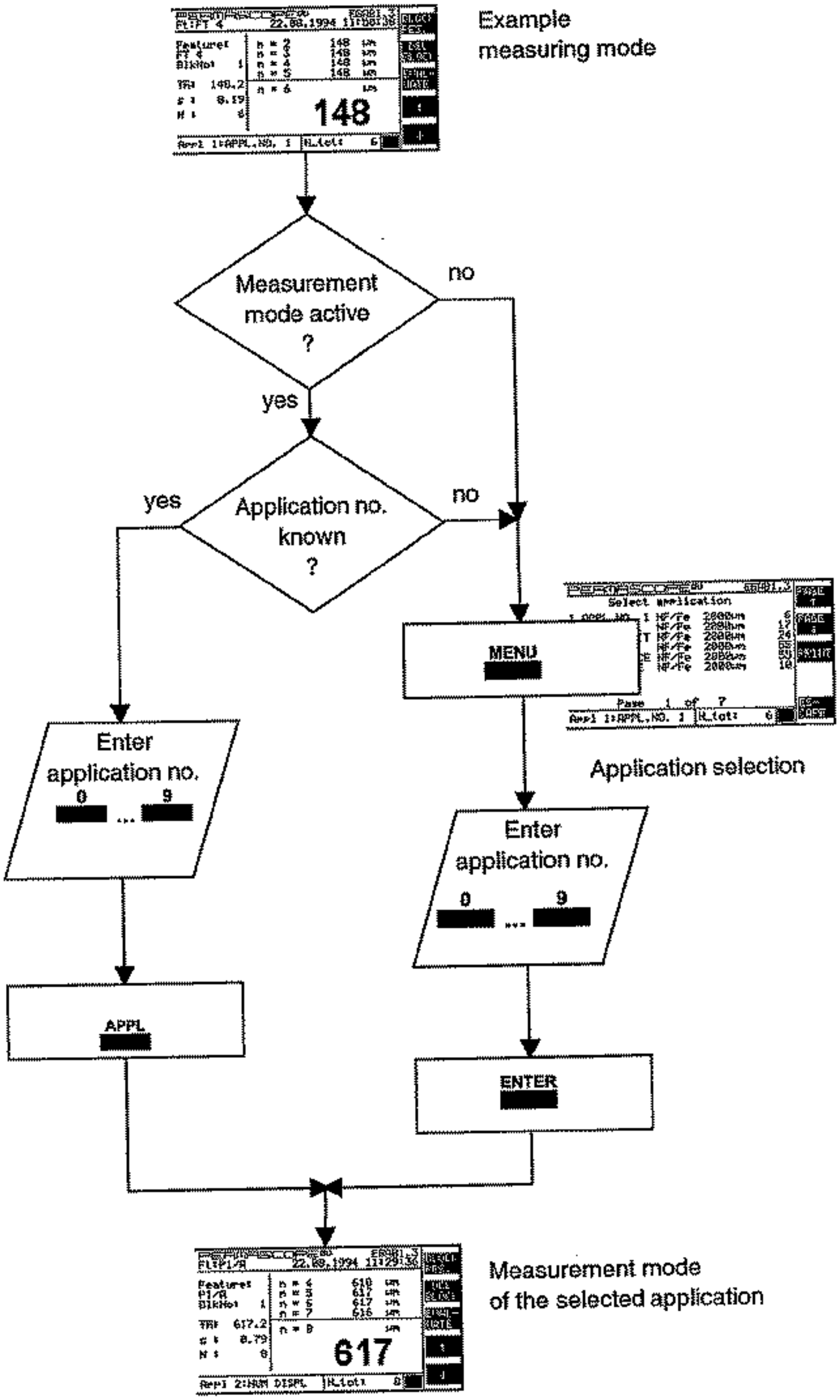
6.1.2 Calling an Application

☞ **"Select an Application"** can be called from the measurement mode, from all menu pages of an application, and from all menu functions using the APPL key.

Selecting an Application follows the same principle in all measuring types.

Calling an Application

APPL

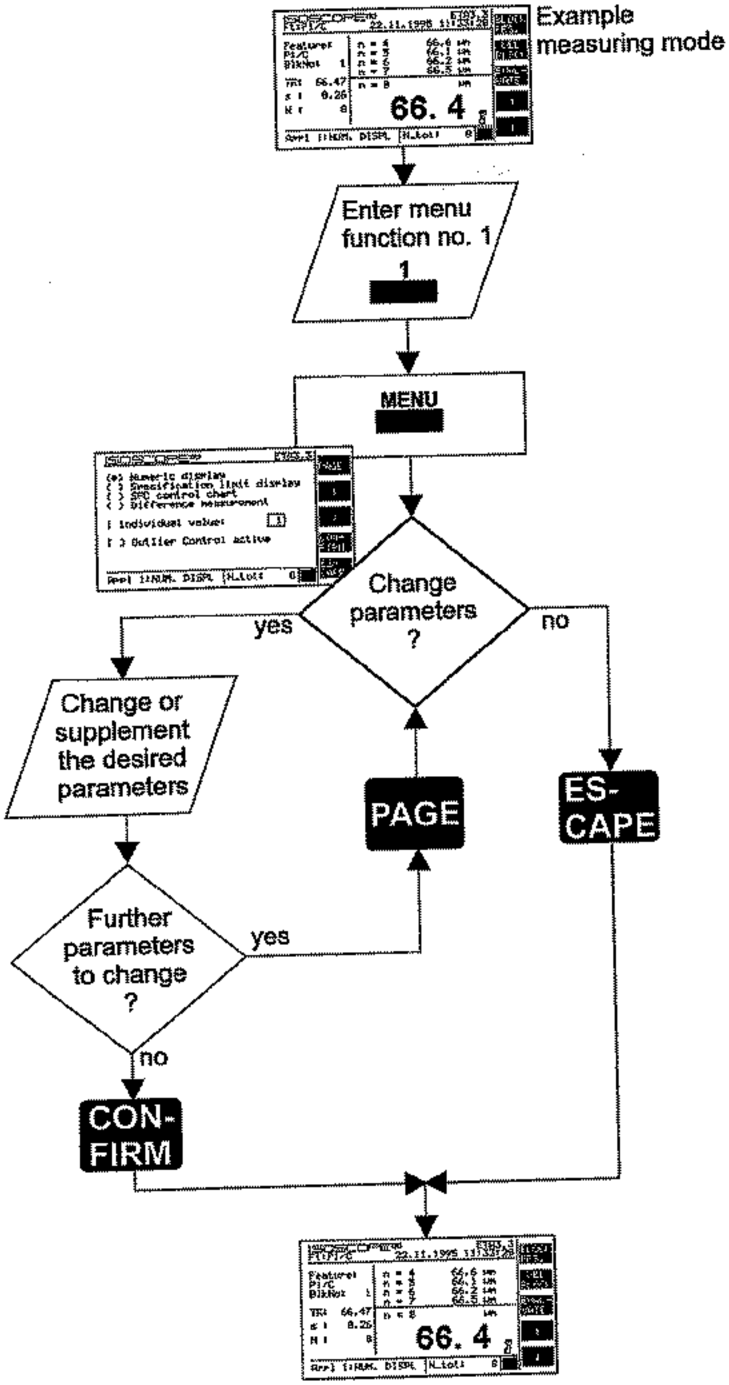


6.1.3 Changing an Application

Parameters of a previously created application can be changed or supplemented at a later date.

☞ If parameters of an **application that already has measurement data stored** need to be changed or supplemented, we recommend to document the data (if not yet done), and then to delete them, or at least to start a new block. The changed parameters may affect the statistical evaluation.

☞ An **Application** for which parameters are to be changed/supplemented **must be active**, i.e., the measurement mode or another menu of the application must be displayed.



Changing an Application

MENU 1 ENTER

or

1 MENU

☞ Use the PAGE softkey to scroll through the menu pages to make all the required settings

See also pages 6-24 to 6-27.

☞ You can quit parameter entry and switch to the measurement mode from any menu page using the softkey CON-FIRM.

For a description of the parameters see Appendix B.

6.1.4 Copying an Application

When copying an application, all parameter settings, the characteristic, and the normalization or calibration will be copied.

Not copied are the measurement data and the name of the application. A new name will be assigned.

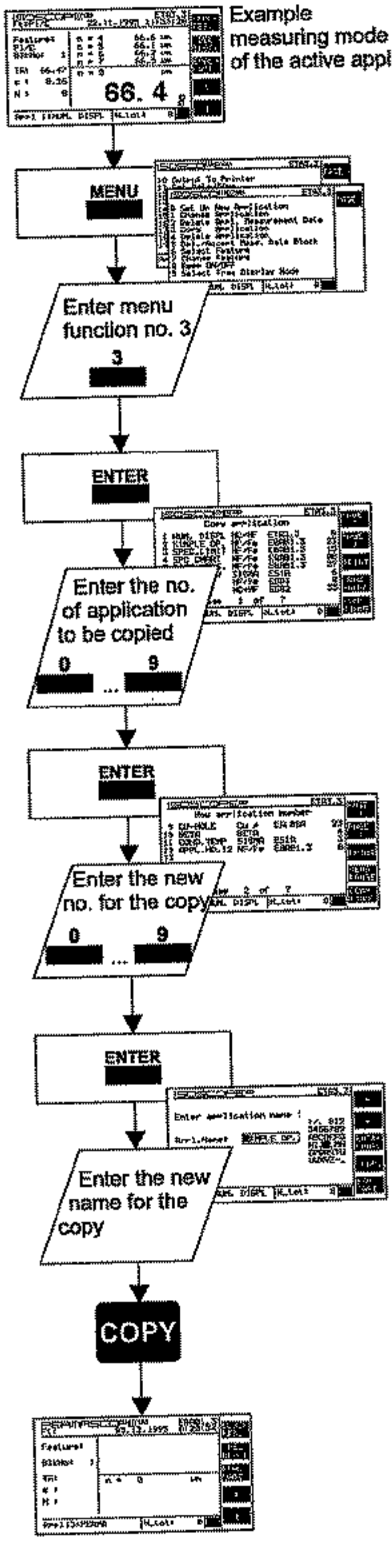
Copying an Application

MENU **3** **ENTER**

or

3 **MENU**

☞ The kind of application that is active (loaded) is of no consequence to the Copy procedure.



On how to enter the name of an application see also Section 'Entering Alphanumeric Characters', Page 6-24.

6.1.5 Deleting an Application

Use menu function number 4, 'Delete Application' to delete an application entirely (parameter settings, characteristic, measurement data).

☞ The **active application** (measurement mode or an other menu screen appears on the display) can not be deleted.

☞ If the **application is secured**, the delete function cannot be executed. Unsecure the secured application. 🗐 See Section "Description of the Menu Function, Page 6-93.

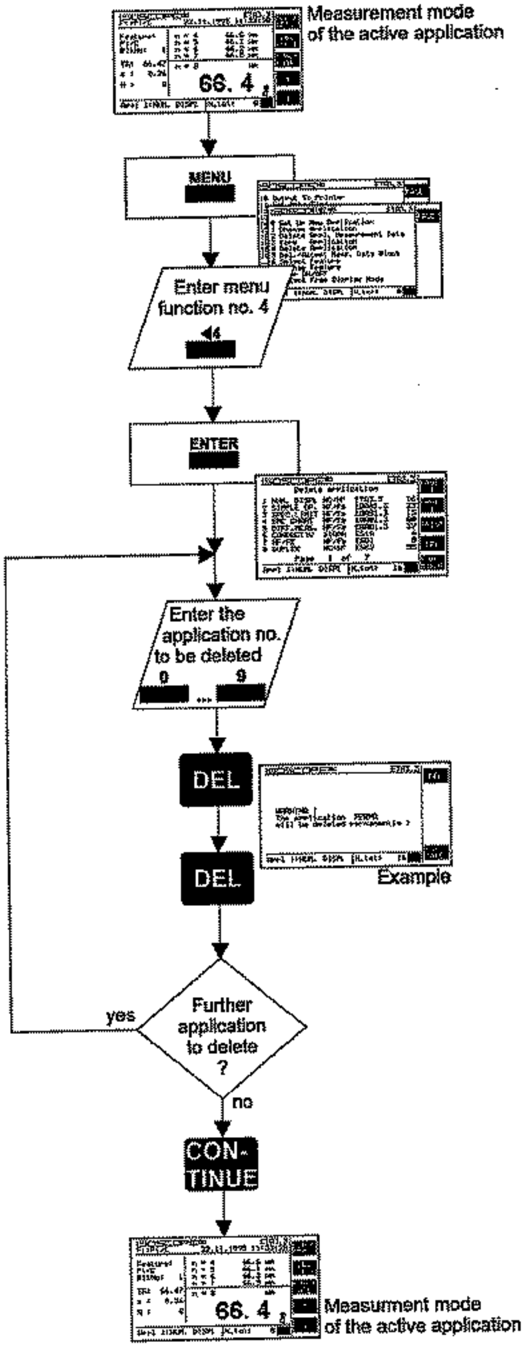
🗐 To delete measurement date of an application, see Section "Deleting Measurement Data", Page 6-15.

Deleting an Application

MENU ◀4 ENTER

or

◀4 MENU



6.1.6 Calling a Menu Function

All menu functions of the FISCHERSCOPE® MMS® are called in the same manner.

Menu Function Overview

No	Measuring Type Menu Function	PERMASCOPE®	ISOSCOPE®	DUALSCOPE®	BETA	SIGMA	NICKELSCOPE®	CU-SCOPE	FERITSCOPE®	SIGMASCOPE®	FISCHERSCOPE®	Page
0	Set Up New Application	●	●	●	●	●	●	●	●	●	●	6-45
1	Change Application	●	●	●	●	●	●	●	●	●	●	6-48
2	Delete Appl. Measurement Data	●	●	●	●	●	●	●	●	●	●	6-50
3	Copy Application	●	●	●	●	●	●	●	●	●	●	6-51
4	Delete Application	●	●	●	●	●	●	●	●	●	●	6-52
5	Del./Accept Meas. Data Block	●	●	●	●	●	●	●	●	●	●	6-53
6	Select Feature	●	●	●	●	●	●	●	●	●	●	6-54
7	Change Feature	●	●	●	●	●	●	●	●	●	●	6-56
8	Beep ON/OFF	●	●	●	●	●	●	●	●	●	●	6-57
9	Select Free Display Mode	●	●	●	-	●	●	●	●	●	-	6-58
10	Output to Printer	●	●	●	●	●	●	●	●	●	●	6-59
11	Set Date/Time	●	●	●	●	●	●	●	●	●	●	6-60
12	Select Units	●	●	●	●	●	●	●	●	●	●	6-61
13	Output to Serial Port	●	●	●	●	●	●	●	●	●	●	6-63
14	Calibration on Coating	●	-	-	-	-	-	-	-	-	-	6-64
	Standards for Master Calib.	-	-	-	-	-	-	-	-	●	-	6-65
15	Master Calibration	●	●	●	-	●	●	●	●	●	-	6-66
	Enter Density	-	-	-	●	-	-	-	-	-	-	6-67
16	Instrument Status	●	●	●	●	●	●	●	●	●	●	6-68
17	Adjust Brightness	●	●	●	●	●	●	●	●	●	●	6-69
18	Disp. Mode/Meas. Trigger	●	●	●	●	●	●	●	●	●	-	6-70

● Function can be executed, ○ Function cannot be executed -Function not available for this measuring type

No	Menu Function / Measuring Type	PERMASCOPE®	ISOSCOPE®	DUALSCOPE®	BETA	SIGMA	NICKELSCOPE®	CU-SCOPE	FERITSCOPE®	SIGMASCOPE®	FISCHERSCOPE®	Page
19	Display Resolution	●	●	●	●	●	●	●	●	●	●	6-73
20	Measurement Time Calculation	-	-	-	●	-	-	-	-	-	-	6-74
	Enter Board Thickness	-	-	-	-	-	-	●	-	-	-	6-75
21	Normalization to Pre-set F_{norm}	-	-	-	●	-	-	-	-	-	-	6-76
	Temperature Calibration	-	-	-	-	-	-	-	-	●	-	6-76
	Enter Correction Factor	-	-	-	-	-	-	●	-	-	-	6-79
22	Calibration to Pre-set F_{cal}	-	-	-	●	-	-	-	-	-	-	6-80
	Probe Sensitivity	-	-	-	-	-	-	●	-	-	-	6-82
23	Normalization without X_s	-	-	-	●	-	-	-	-	-	-	6-83
24	Info for Last Measurement	-	-	-	●	-	-	-	-	-	-	6-84
25	Automatic Measurement	-	-	-	●	-	-	-	-	-	-	6-85
28	Store / Do Not Store Readings	●	●	●	●	●	●	●	●	●	●	6-87
29	Supervisor-Menu	●	●	●	●	●	●	●	●	●	●	6-88
29 30	Printer Selection	●	●	●	●	●	●	●	●	●	●	6-89
29 31	Serial Port Configuration	●	●	●	●	●	●	●	●	●	●	6-90
29 32	Assign New Probe	●	●	●	○	●	●	●	●	●	-	6-91
29 33	Secure/Unsecure Application	●	●	●	●	●	●	●	●	●	●	6-93
29 34	Simple/Normal Mode	●	●	●	●	●	●	●	●	●	●	6-95
29 35	Automatic Switch-OFF	●	●	●	●	●	●	●	●	●	●	6-97
29 36	Lift-Off-Compensation	-	-	-	-	○	-	-	-	○	-	6-98
	Set DUAL Method	-	-	●	-	-	-	-	-	-	-	6-98
29 37	Linking of applications	●	●	●	-	●	●	●	●	●	-	6-100
29 38	Control Line Level	●	●	●	●	●	●	●	●	●	●	6-102
29 39	Calculation of control limits	●	●	●	●	●	●	●	●	●	●	6-103
29 40	Allow adapter 19/8	●	●	●	-	-	-	-	-	-	-	6-104

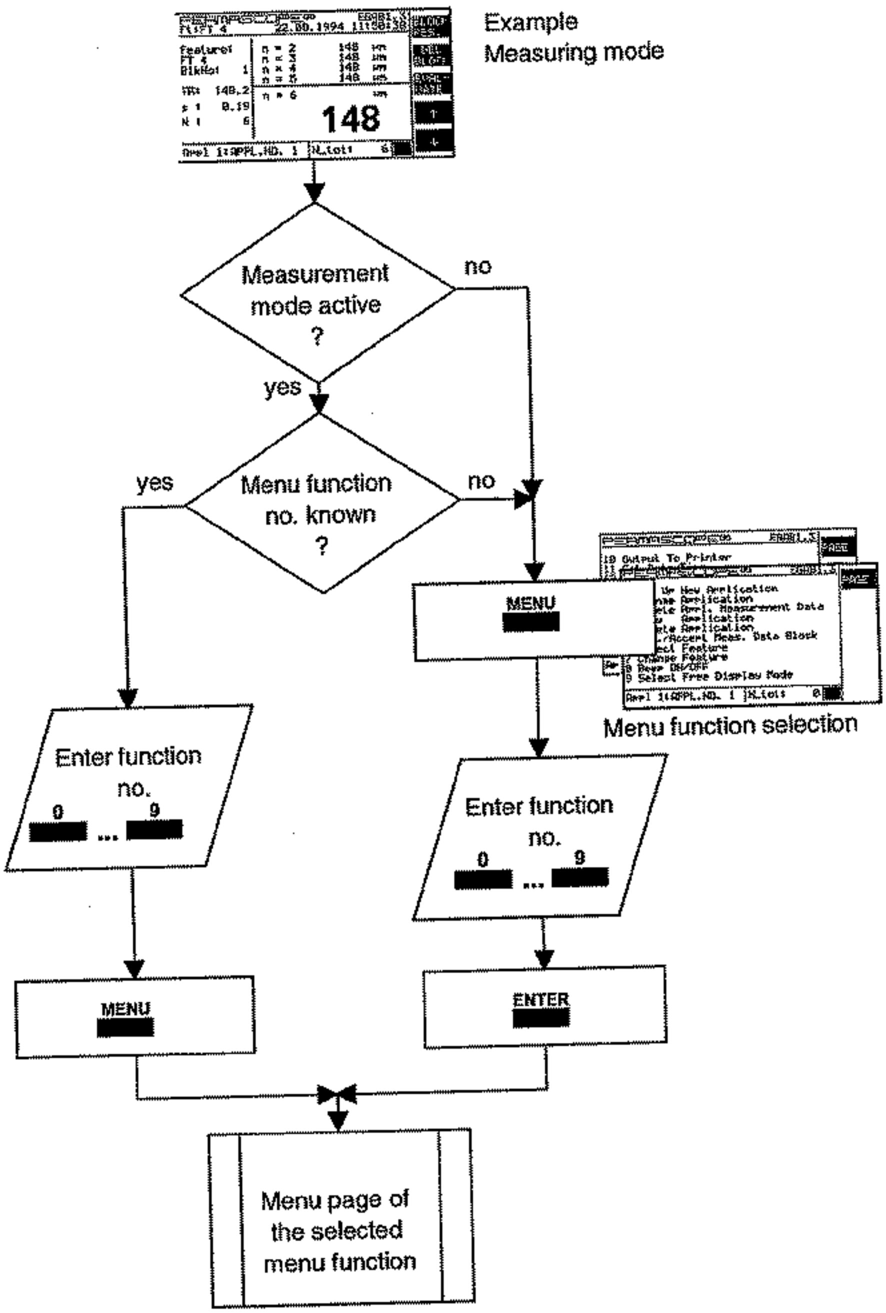
● Function can be executed, ○ Function cannot be executed, -Function not available for this measuring type

A description of the individual menu functions can be found beginning on page 6-43.

Calling a Menu Function

MENU

☞ You can call a menu function from the menu function overview, from every menu screen of an application, or from a menu function using the **MENU** key.



6.1.7 Calling the Normalization Function

🗐 For more information about normalization of the various measuring types see Chapter 7.

☞ The normalization functions affects only the **active application** and can only be **called from** the **measurement mode of the active application** .
Exception: When the Application Linking Mode is active, the normalization function affects all applications which have been set up for the same measuring type and the same (equal) probe as the active application. 🗐 See also Section '37 Linking of application', page 6-100.

☞ Menu functions and applications can be called from the normalization function using the MENU and APPL keys. This terminates normalization.

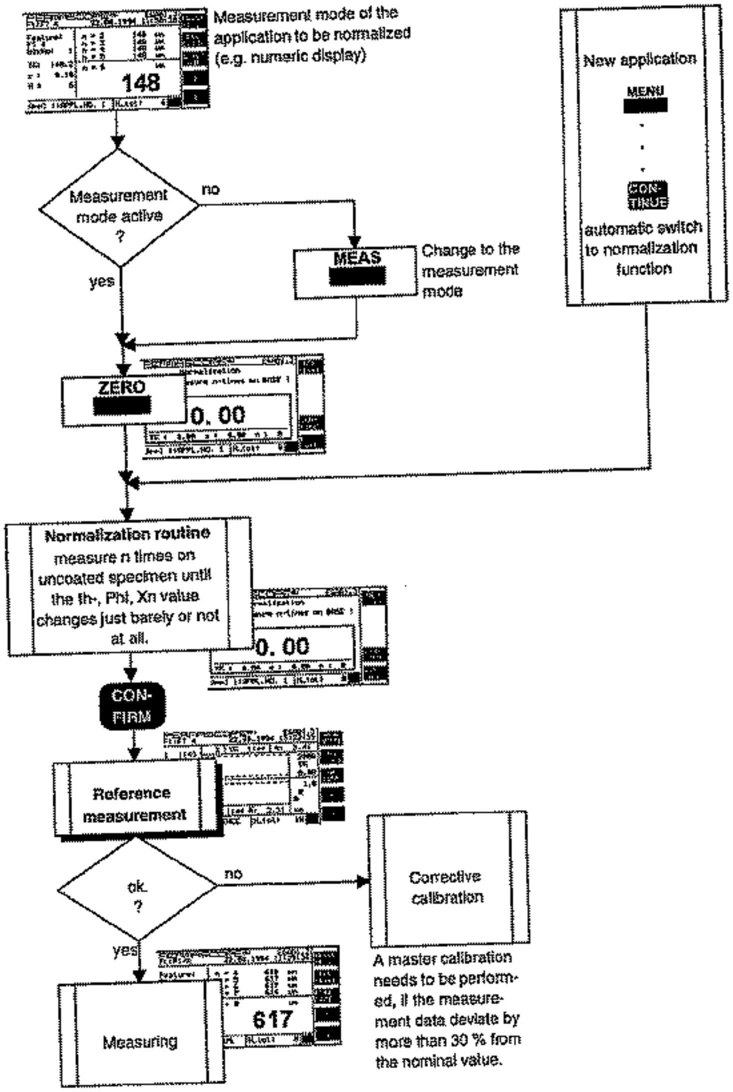
☞ In the normalization function the **MMS® cannot be switched OFF**.

☞ The normalization function is not available for the **measurement method FISCHERSCOPE®** (RS232 Applications).

- Call the application for which a (new) normalization is to be performed.

Normalization Function

ZERO



☞ We recommend making a reference measurement to avoid measurement errors.

🗐 See Section "Reference Measurement" on page 6-34.

6.1.8 Calling the Calibration Function

Call the calibration function (corrective calibration) using the CAL key. In addition, a master calibration and, for the magnetic induction method, a calibration on the coated specimen are available. The latter two functions are called from the menu function overview (MENU key).

For more information about calibration of the various measuring types see Chapter 7.

☞ The calibration function affects only the **active application** and can only be **called from** the **measurement mode of the active application**!
Exception: When the Application Linking Mode is active, the normalization function affects all applications which have been set up for the same measuring type and with the same probe as the active application. See also Section '37 Linking of application', page 6-100.

☞ **Menu functions and applications can be called** from the calibration function using the MENU and APPL keys. This terminates the calibration.

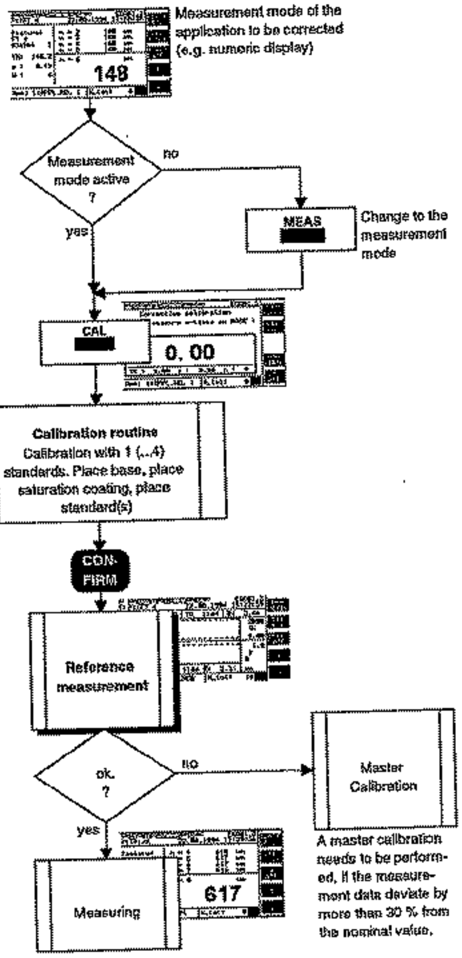
☞ Use the DEL CAL key to delete the calibration from the application memory.

☞ The calibration function is not available for the measurement method FISCHERSCOPE® (RS232 Applications).

Calibration Function (Corrective Calibration)

CAL

- Call the application for which a (new) calibration is to be performed.



☞ We recommend making a reference measurement to avoid measurement errors.

See Section "Reference Measurement" on page 6-34.

6.1.9 Canceling a Menu Function

Any function can be canceled using either softkey ES-CAPE or the MEAS key. The function will not be performed. Entries or measurements that have already been made will be disregarded. The system switches to the measurement mode of the active application.

ES-CAPE

or

MEAS

6.1.10 Quitting a Menu Function

Use the softkey CON-TINUE to exit a menu function not used for instrument settings and that is not associated with the active application. If applicable, the entries/settings will be executed. This applies to Menu 3 'Copy Application', 4 'Delete Application', 5 'Del./Accept Meas. Data Block', 16 'Instrument Status', 17 'Adjust Brightness', and 33 'Secure/Unsecure Application'.

CON-TINUE

6.1.11 Finishing a Menu Function

In general, you can close functions using either softkey CON-FIRM or CON-TINUE. Functions are executed according to the active application. The system switches to the measurement of the active application.

CON-FIRM

or

CON-TINUE

6.1.12 Deleting Measurement Data

There are two ways for deleting measurement data:

- Single readings of an application
- All measurement data of an application

Deleting Single Readings of an Application

Erroneous measurements, for instance those caused by improper placement of the probe, can be deleted.

Deleting Single Readings

DEL

Deleting Single Readings
(continued)

Deleting the Last Captured Measurement:

- Press the DEL key.

Deleting an Earlier Measurement $(n < n_{current})$:

- Select the measurement to be deleted using the arrow softkeys (↑, ↓ or ←, →).
- Press the DEL key.
  The measurement will be deleted and can be replaced with a new one.

☞ If you continue to make measurements, a new block will start automatically after the last measurement $(n_{current})$.

Deleting All Measurement Data of an Application

MENU ▼2 ENTER

or

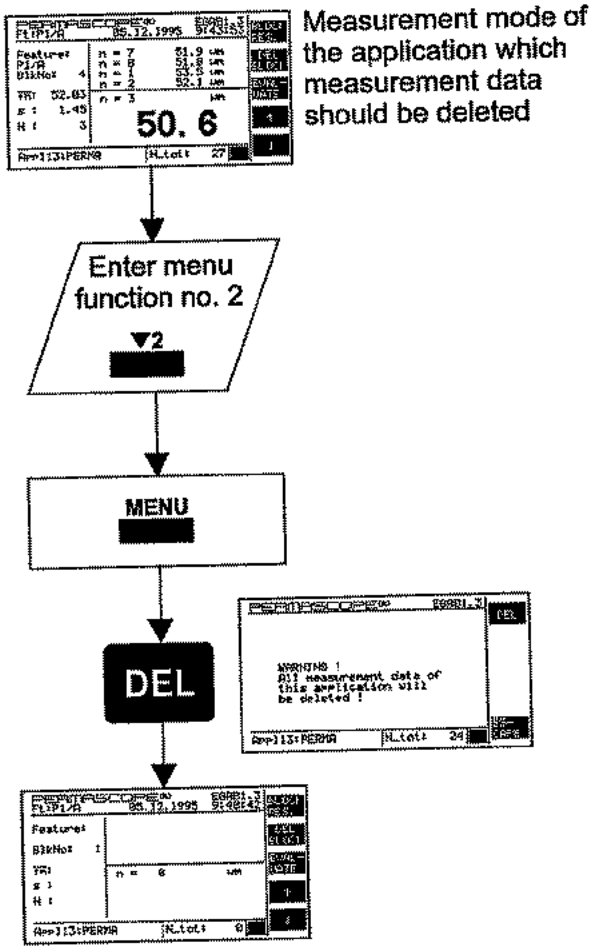
▼2 MENU

Deleting All Measurement Data of an Application

☞ Only the measurement data of the **active application** will be deleted. All parameter settings and the normalization/calibration remain.

☞ **Features** of an application are deleted along with the measurement data.

- Call the application whose measurement data are to be deleted.



WARNING !
All measurement data of this application will be deleted !

6.1.13 Creating a Block

The measurements of an application can be separated into blocks. A block is a group of measurements. Blocks are always created during the measurement - automatically or manually.
A block of measurements may represent the measurements on a single test specimen over the significant surface.

Automatic Block Creation

1 **MENU**

or

0 **MENU**

Creating a Block Automatically:

- This function is activated through the parameters of the menu functions 0 and 1 (parameter: automatic block result, n measurements per block).

  Example: Automatic Block Result (Batch Result) is activated and 5 measurements per block are set. Measurements are made continuously. After every 5 measurements, the MMS® automatically closes a block and marks the end with a block separator. Shown in the numeric display as a key.

☞ **Signal**: a long acoustic signal will sound after each automatically created block.

▤ See Section "0 'Set Up New Application'", Page 6-45, Menu Function 1 'Change Application', Page 6-48.

Manual Block Creation

BLOCK RES.

Creating a Block Manually:

- Press the softkey BLOCK RES. after the desired number of measurements.

  Example: make 5 measurements, press softkey BLOCK RES. to display a menu page with the block result of the first block, press softkey CON-TINUE to return to the measurement mode; make another 5 measurements, press softkey BLOCK RES. to display a menu page with the block result of the second block, etc.

☞ For time reference, the current date and time are stored whenever a **block is closed.**

☞ **A feature can be assigned to each block.** Evaluations can then be performed according to features, for example. ▤ see also page 6-21.

☞ A **key** in the numeric display **indicates the end of each block.**

☞ **A block is closed automatically,** regardless of the parameter settings, when exiting the application, when switching to another application, or when switching off the instrument.

6.1.14 Deleting a Block

Basically, only open blocks can be deleted. An open block is a group of measurement data where the end of the block has not yet been generated (manually or automatically; indicated by a key in numeric display).

DEL BLOCK

Deleting an open block with the softkey DEL BLOCK:

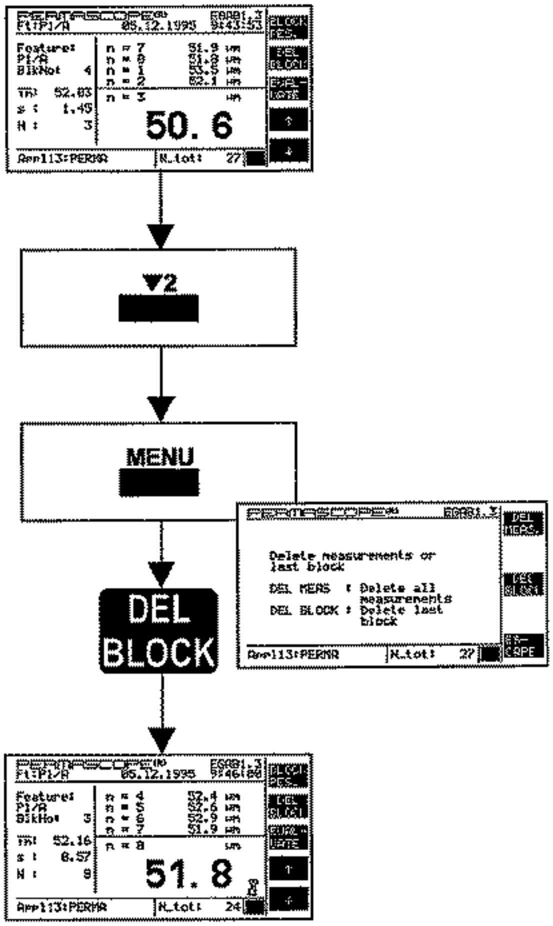
- The measurement mode of the active application must be open.
- Press the softkey DEL BLOCK. All measurement data back to the previous block will be deleted. The selected feature remains active.

▼2 MENU

or

MENU ▼2 ENTER

Deleting an open block using Menu 2:



Delete measurements or last block

DEL MEAS : Delete all measurements

DEL BLOCK : Delete last block

☞ For the **BETA measuring type**, an open block can only be deleted using menu 2.

6.1.15 Defining/Changing a Feature

Each block (measurement series) of an application can be characterized by a feature defined by the user. For instance, blocks of an application that are to be combined for an evaluation can be characterized by a certain feature. In the evaluation menu, all blocks with the same feature can be combined for an evaluation.

A feature consists of a maximum of 5 alphanumeric characters. A feature may be a name, order number, batch name, etc. or may designate a certain area, or other characteristic of the test specimen. Examples: door, cover, hood, etc.

10 features can be specified in the respective menu function 7 'Change Feature'.

▤ For an example on how to define/change features see Chapter 4, Example 2 PERMASCOPE®.

▤ See page 6-56 for a description of menu function 7 'Change Feature'.

☞ **Defining Features** is performed independent of the active application.

☞ FT1 to FT10 serve as default labels on the **menu page** of the menu function 7 'Change Feature'.

☞ To **assign a feature** to a open block use menu function 6 'Select Feature'.
▤ See also page 6-21.

☞ See page 6-23 on how to assign a feature to a closed block.

For the procedure on how to define/change a feature see the flow diagram on the next page.

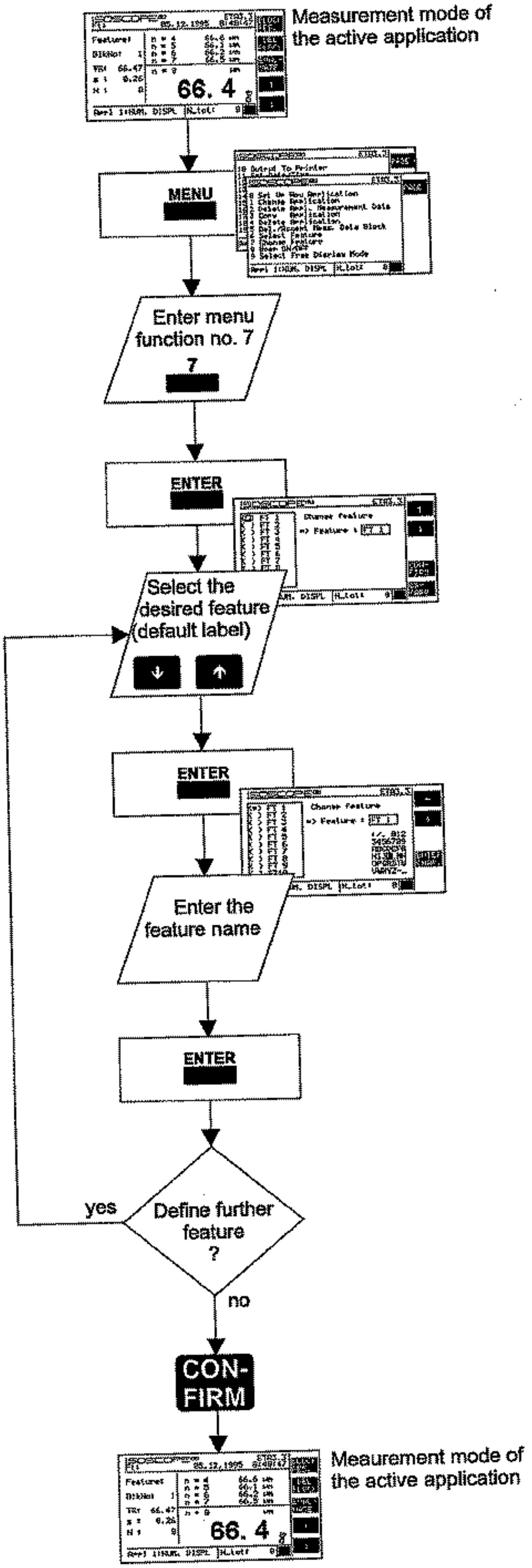
Defining/Changing a Feature

MENU **7** **ENTER**

or

7 **MENU**

On how to enter alphanumeric characters see Page 6-24.



Measurement mode of the active application

Meaurement mode of the active application

6.1.16 Assigning a Feature

Each block of an application can be assigned a feature (user-defined characterization). The feature is defined in menu function number 7, 'Change Feature', and assigned to the respective block with menu function number 6, 'Select Feature'.

For an example on how to assign features to an open block see Chapter 4, Section Example 2 PERMASCOPE®.

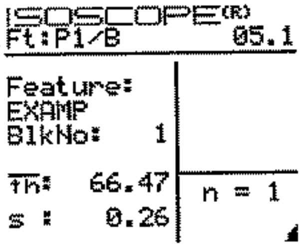
See page 6-54 for a description of menu function 6 'Select Feature'.

☞ The **application** you wish to measure in must be active, i.e., the measurement mode must appear on the display.

☞ **A feature can also be assigned to a closed block** (measurement series). See page 6-23.

☞ If a block is still open (measurement series is not finished) the feature selected last will be assigned/confirmed at the end of the block. The '**active feature**' is shown on the display underneath the measuring type. In the example on the right side: Ft: P1/B.

☞ The **assigned feature** of a closed block **may** also **be changed** later on. See page 6-23.



```
ISOSCOPE(R)
Ft:P1/B          05.1
Feature:
EXAMP
BlkNo:    1
Th:   66.47    n = 1
s :    0.26
```

Example: Assign feature

Assigning a feature to an open block:

Any feature stored in menu function 7 can be selected either immediately prior to the start of a block (prior to making the first measurement of the block) or during the measurement in a block. For the particular block, the feature will then be stored with the block upon closing the block.

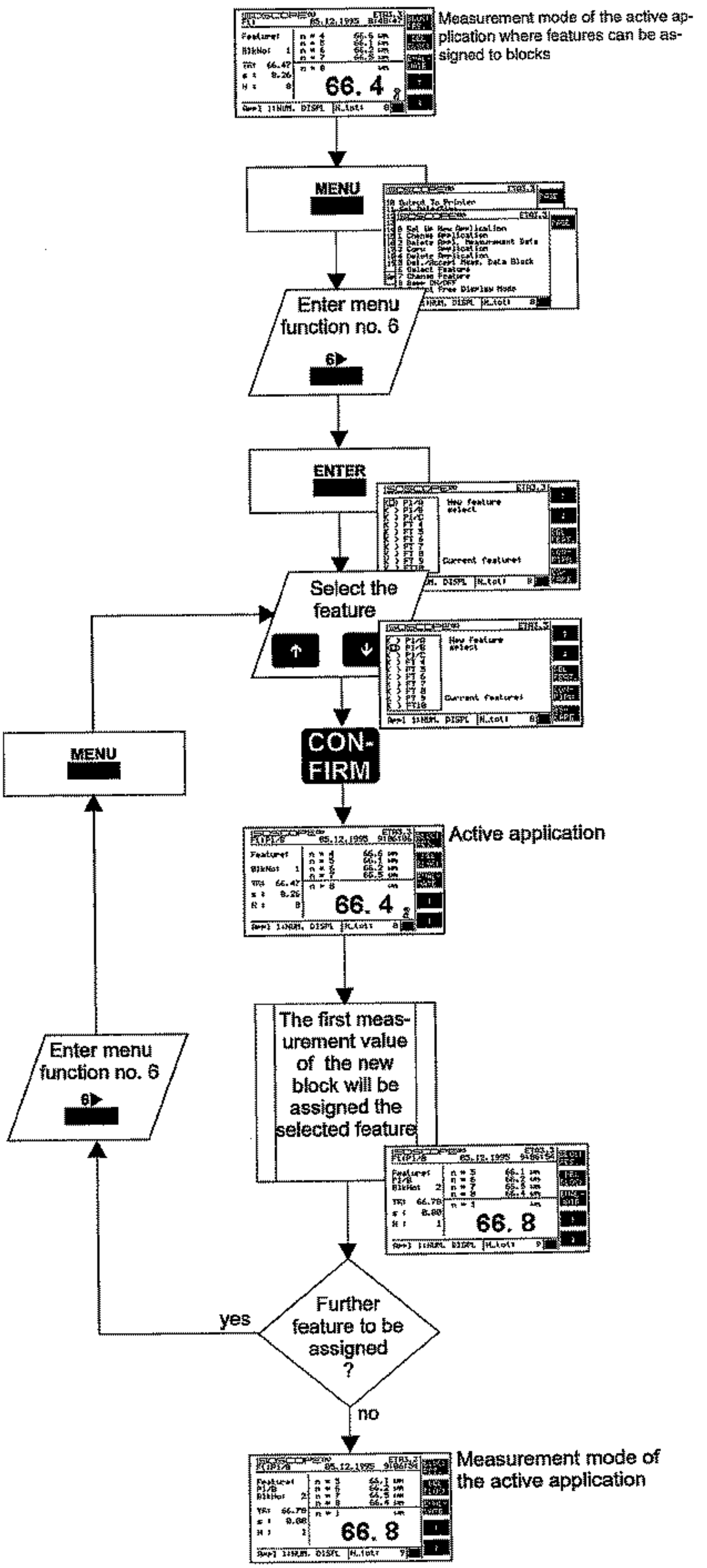
For the procedure on how to assign a feature see the flow diagrams on the next pages.

Assigning a Feature to an Open Block

MENU **6▶** **ENTER**

or

6▶ **MENU**

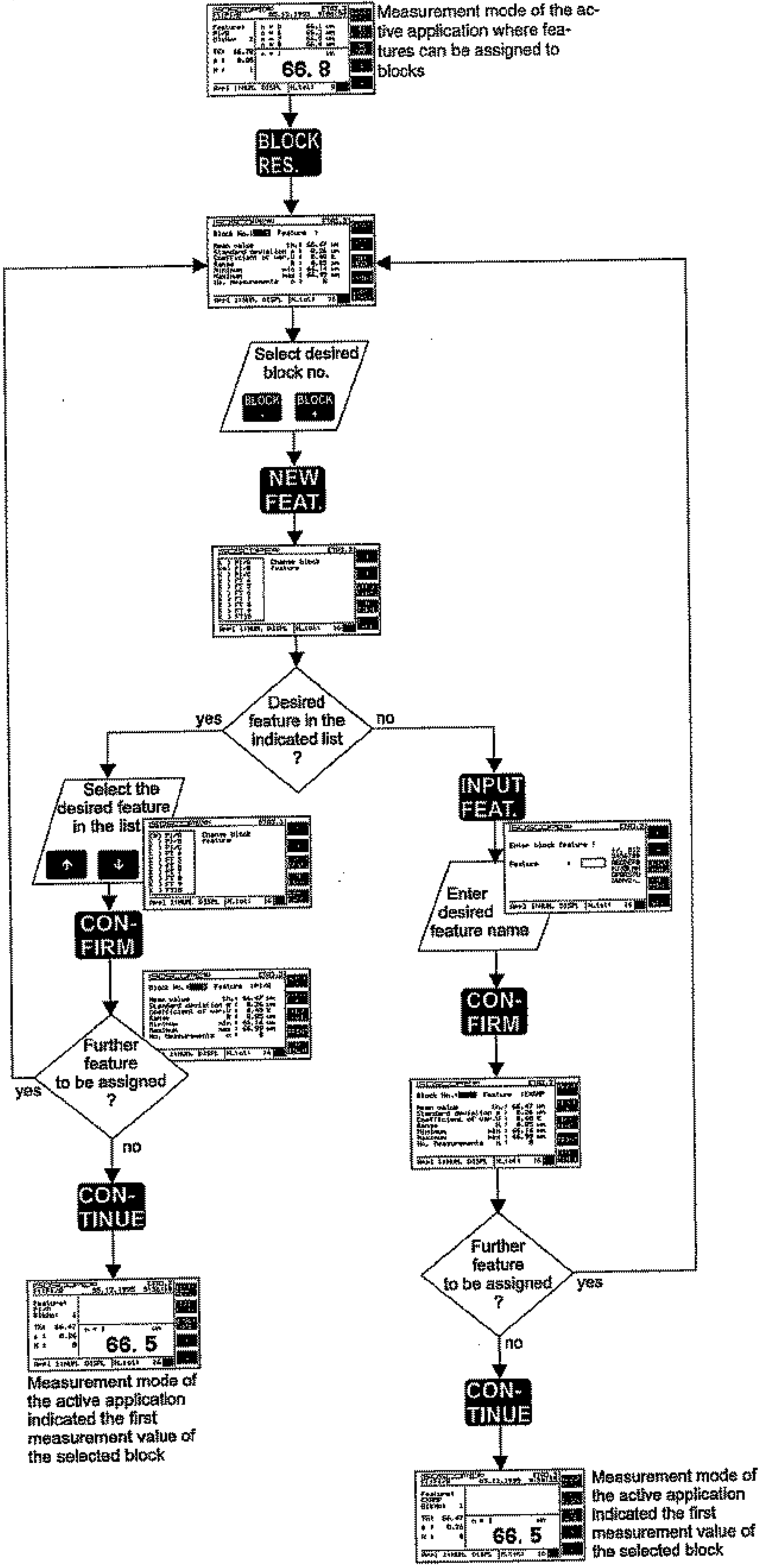


Measurement mode of the active application where features can be assigned to blocks

Active application

Measurement mode of the active application

Assigning/Changing a Feature of a Closed Block


Measurement mode of the active application where features can be assigned to blocks

Measurement mode of the active application indicated the first measurement value of the selected block

Measurement mode of the active application indicated the first measurement value of the selected block

Assigning/Changing a Feature Later On

☞ Pressing the softkey BLOCK RES. closes a block automatically regardless of the parameter settings.

☞ Assigning/Changing a feature of a block is **not possible in SPC Chart display mode.**

See page 6-24 on how to enter alphanumeric characters.

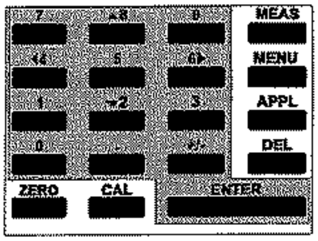
Entering Numbers

6.1.17 Entering Numbers

The Function menu page includes entry boxes for parameters or text (names, features).

The entries can be numeric values for the parameters or text for names or features.

This section covers the entry of numeric values. They are used for parameters, date, time, etc.



MMS® Keypad

- Numeric values are entered using the number keys of the keypad.
- The cursor (dark highlight) will flash in the active entry box.
- Units of measurement are not entered along with the numbers.

Entry Box (Example)

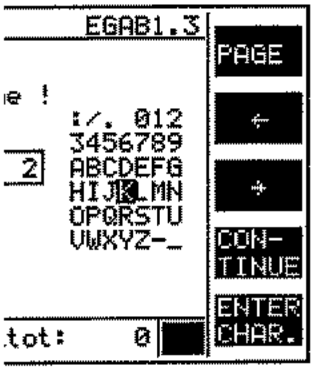
6.1.18 Entering Alphanumeric Characters (Letters, Numbers)

The function menu pages include entry boxes for parameters or text (names, features).

Numeric values can be entered for the parameters and text for the names or features.

This section covers text entries consisting of numbers, letters, or a combination of both.

To enter names or features a character field with all available characters appears on the respective menu page (see the illustration on the side)

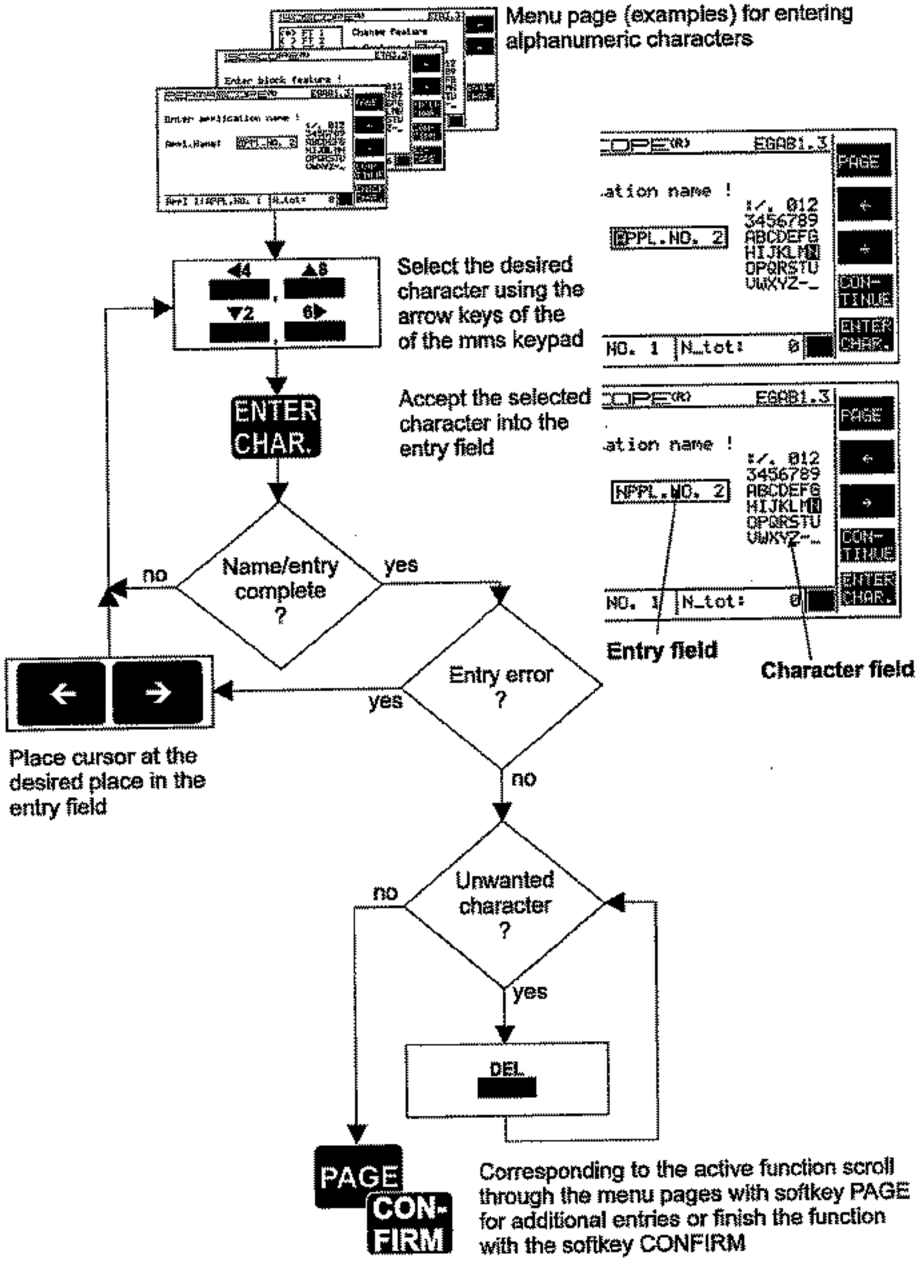


Example: Menu Function 0, 'Set Up Application', menu page to enter the name of the application.

- Use the +/- key to switch between capital and small letters in the character field.
- Use the arrow keys of the keypad (▼2, ◀4, 6▶, ▲8) to select the desired character from the character field. Accept the selected character into the entry box with the softkey ENTER CHAR..
- The characters from the character field are confirmed in the type-over mode.
- Use the softkeys ← and → to move the cursor in the entry box to the left or to the right.

See the next page for the corresponding flow diagram.

Entering Text, Names
(continued)



Menu page (examples) for entering alphanumeric characters

Select the desired character using the arrow keys of the mms keypad

Accept the selected character into the entry field

Place cursor at the desired place in the entry field

Corresponding to the active function scroll through the menu pages with softkey PAGE for additional entries or finish the function with the softkey CONFIRM

Deleting Numbers

DEL

6.1.19 Deleting Numbers

- Use the DEL key to delete one or more numbers, then enter new numbers.

6.1.20 Deleting Alphanumeric Characters

... When Entering Text (Name/Feature)

Typing Over Characters

Typing Over an Erroneous Entry

- Use the softkeys ← and → to select the erroneous character in the entry box.
- Use the arrow keys of the keypad (▼2, ◀4, 6▶, ▲8) to select the correct character from the character field and the softkey ENTER CHAR. to type over the erroneous character.

Deleting Excess Characters

DEL

Deleting Excess Characters

- Use the DEL key to delete any number of characters starting from the position of the cursor.

6.1.21 Selecting Parameters

In addition to the entry boxes, the menu pages may also contain other specified settings that can be selected. They are activated or selected using softkeys.

Activate/Deactivate Specified Settings

ON OFF

`[ ] Outlier Control active`

Activating/Deactivating Specified Settings

You will always find brackets to the left of a specified setting (see example).

- Activate or deactivate the specified setting with the softkey ON OFF.
  Activated setting: [X]
  Deactivated setting: [ ]

Selecting Specified Settings

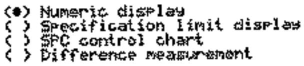
Parentheses are always found to the left of specified settings that can be selected (see example).

- Use the softkeys ↑ and ↓ to move the cursor (point) to the desired specified setting.
  (●) The specified setting that has been selected, will be executed or accepted into the Application at the end of the menu function.
  ( ) The specified setting that has not been selected, does not affect the application.

☞ The cursor marks the selected function setting to be executed.

Selecting Parameters

↑ / ↓



```
(•) Numeric display
( ) Specification limit display
( ) SPC control chart
( ) Difference measurement
```

6.1.22 Move Cursor on Menu Page

Use the ENTER key of the keypad to move to the individual specified settings and to the entry boxes of a menu page.

Use the arrow softkeys to move the cursor within an entry/selection box.

☞ If **arrow softkeys** are **not available,** the arrow keys (▼2, ◀4, 6▶, ▲8) of the keypad assume their function.

Move Cursor/Selection on a Menu Page

ENTER

... in the Entry Box

↑ / ↓ or
→ / ←

6.1.23 Scrolling Through the Menu Pages

- Use the softkey PAGE to scroll through the menu pages of a menu function.

Scrolling Through the Menu Pages

PAGE

Printing Measurement Data

6.1.24 Printing Measurement Data

You can print out measurement data and statistical evaluations.

☞ If a printer is connected and switched on, the measurement data are printed automatically when the **normalization and calibration function** (ZERO, CAL) is called, regardless of the setting in menu function 10, 'Output to Printer'.

Documenting Measurement Data...

- Connect the printer (PRINTER socket), then switch it ON.
- Select the correct printer model:

▼2 9 :	Call the Supervisor menu
1 5 9 :	Enter the Supervisor code
3 0 :	Call menu function 30, 'Printer Selection'
↓ ↑ :	Select the correct printer (9-, 24-pin, Laser)
CON-FIRM :	Confirm the selection

Select the desired output mode:

1 0 :	Call menu function 10 'Output to Printer'
↓ ↑ :	Select the desired output mode
CON-FIRM :	Confirm the selection

- Select the application that data are to be printed for (application number, APPL).

... during a measurement	**... after a measurement**
Start the measurement. During a measurement, either, no, all, and/or the block results are printed out, depending on the selection made in menu function 10, 'Output to Printer'.	● Call the Evaluation menu: Press softkey EVAL-UATE in the measurement mode of the active application.
	● Press softkey PAGE to scroll to the next menu page.
	● Print the measurement data and/or the block result: Press softkey PRINT . Either no, all, and/or the block results are printed out, depending on the selection made in menu function 10, 'Output to Printer'.

Printing Measurement Data
(continued)

☞ Selections made in menu function 30 of the Supervisor menu and in menu function 10 apply to **all Applications.** The selections can be changed at any time.

☞ When the **parameter "Print Automatic Evaluation" is activated** in menu function 0 or 1 for the current application, the printing of the measurement data will be performed according to the parameter settings in menu function 10 <u>and</u> menu function 0 or 1.

☞ **Deletion of print headers:** A print header may be deleted from the menu page "Report Selection". First select the print header to be deleted, then use the D key to make the deletion. 4 Also refer to the section "Deleting a print header" on page 6-31.

☞ **User-specific print forms** can be assigned separately to a block result or to the final evaluation. The appropriate selections are made in menu function 1 and 0. These settings are application specific.

☞ Menu function 10, 'Output to Printer', does not affect **difference measurements**.

☞ **A separate printer menu is available for the difference measurement** (can be called with softkey PRINT), Use this menu to print all measurement data of all test points of all samples, all measurement data of one test point of a selected sample, or all measurement data of all test points of a selected sample.

Printing Out a Statistical Evaluation

Print an Evaluation

In the statistical evaluation (EVAL-UATE), the various presentation modes can be printed out.

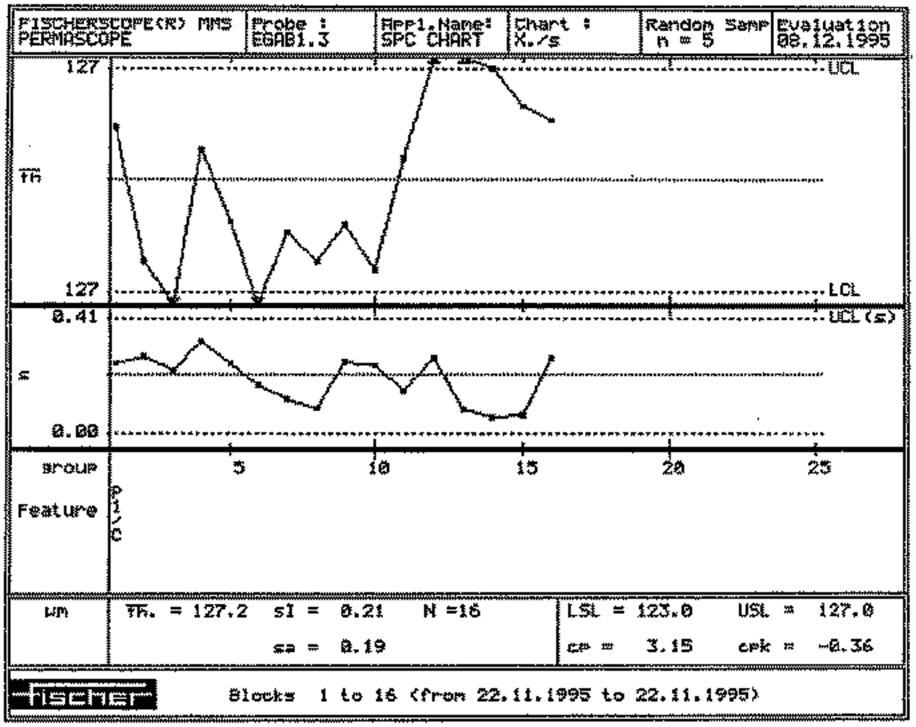
- Use the softkey PRINT to print the measurement data in the respective presentation mode (SPC Chart, Statistics, Histogram,); see the following examples.

Examples

```
F I S C H E R S C O P E   MMS  :      PERMASCOPE
E V A L U A T I O N
Appl.Name   :   SPC CHART
Block No.:      1 (22.11.1995  11:10) to     16 (22.11.1995  11:12)

Mean value   th.. :    127.2 um    Group size     n  :           5
Mean Std.Dev.  sI :     0.21 um    Number Groups  ngr:          16
Mean  Range    R. :     0.46 um    Lowest Group      :     126.9 um
Std.Dev (th.)  sa :     0.19 um    Highest Group     :     127.6 um
Lower Control Lim.LCL: 127.0 um    Groups < LCL  :     2    12.50 %
Upper Control Lim.UCL: 127.5 um    Groups > UCL  :     2    12.50 %
Lower spec. limit LSL: 123.0 um    Values  < LSL :     0     0.00 %
Upper spec. limit USL; 127.0 um    Values  > USL :    60    75.00 %
cp =     3.15                      cpk =   -0.36
```

Example 1:Block result

Print Evaluation
(Examples continued)



FISCHERSCOPE(R) MMS PERMASCOPE
Probe : EGAB1.3
Appl.Name: SPC CHART
Chart : X./s
Random Samp n = 5
Evaluation 08.12.1995

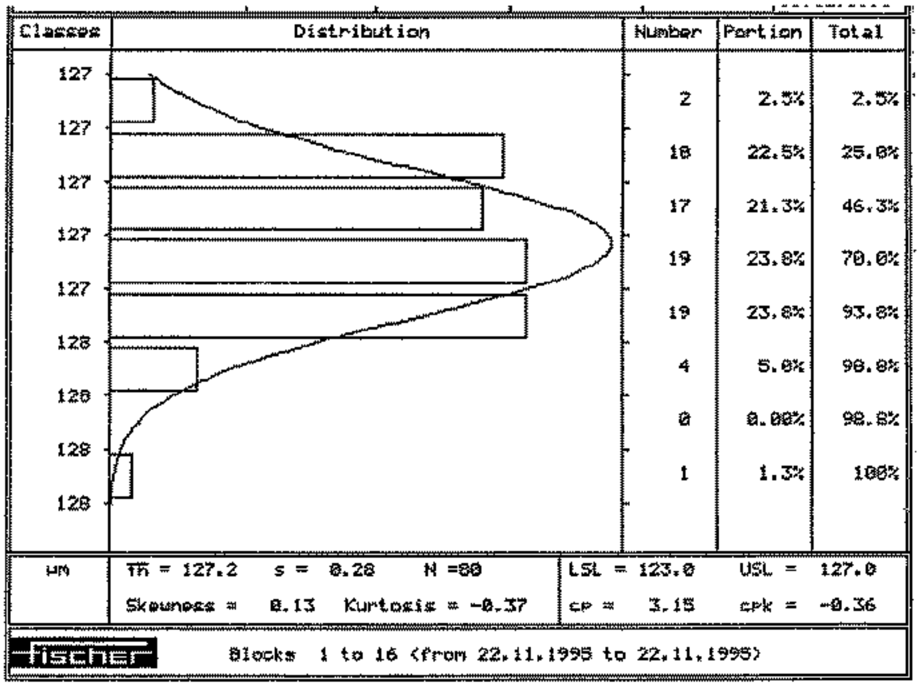
µm

$\overline{\text{Th}}$. = 127.2 sI = 0.21 N =16
sa = 0.19

LSL = 123.0 USL = 127.0
cp = 3.15 cpk = -0.36

fischer Blocks 1 to 16 (from 22.11.1995 to 22.11.1995)

Example 2: Measurement display in SPC Chart with calculated control limits



Number	Portion	Total
2	2.5%	2.5%
18	22.5%	25.0%
17	21.3%	46.3%
19	23.8%	70.0%
19	23.8%	93.8%
4	5.0%	98.8%
0	0.00%	98.8%
1	1.3%	100%

µm

$\overline{\text{Th}}$ = 127.2 s = 0.28 N =80
Skewness = 0.13 Kurtosis = -0.37

LSL = 123.0 USL = 127.0
cp = 3.15 cpk = -0.36

fischer Blocks 1 to 16 (from 22.11.1995 to 22.11.1995)

Example 3: Measurement display in Histogram

Deleting print forms or reports or print headers

6.1.25 Deleting a Print Header

Deleting of the reports (user-specific print forms) stored in the MMS®. A print header may be deleted from the menu page "Report Selection" of menu function 1.

- 1 MENU: Call menu function 1.
- Repeatedly push the CON-TINUE softkey until the menu page "Report Selection" appears.
- Use the ↑ and ↓ softkeys to select the printer header (report) you want to delete.
- Push DEL key. To safeguard against accidental deletion, a window with the name of the print header will open and you will have to confirm the deletion.

☞ Abort the deletion by using the RE-TURN softkey.

- Delete the print header with the DEL softkey.

☞ Print headers may be created by PC with the Report Software.

Print All Parameter Settings of an Application

6.1.26 Printing Application Data

A list of all parameter settings can be printed for a selected application:

- Press the APPL key.
- Enter the number of the application whose parameter settings are to be printed. Use the keypad to enter the application number (0 ... 9).
- Press the softkey PRINT. A list of all parameter settings will be printed for the selected application.

☞ If **no application numbers are entered**, the parameter settings of the application selected last (current application) will be printed automatically after pressing PRINT .

6.1.27 Printing Instrument Parameters and the Application List

Print Instrument Parameters + Application List

The instrument parameters of menu function 16 'Instrument Status' listed (e.g., software version, interface data format, printer model, etc.) are printed out with an application list using the softkey PRINT.

- 1 6▶ MENU: Call menu function 16.
- Press softkey PRINT. A list of instrument parameters and stored applications (number and name) will be printed.

6.1.28 Display Symbols

Display Symbols

Wrong

- In previously defined applications, measurements must always be made with the same probe that was used for the normalization (corrective calibration) of the application. If this probe is not used, but only the same probe model, the message "Wrong" will appear in the upper right corner of the display. It will not be possible to measure, normalize and calibrate. 📄 See also Chapter 6, Section '32 Assign New Probe', Page 6-91.

Missing

- If another probe type (other test method) is connected to the instrument, the message "Missing" will appear in the upper right corner of the display, instead of the probe type. It will not be possible to measure, normalize and calibrate.

Equal

- If two of the same probe types (same test method) are connected to the PERMASCOPE® sockets, the message "equal" will appear on the display, instead of the probe type. It will not be possible to measure, normalize and calibrate.
  📄 See also Chapter 3, Section 'Connecting a Probe', Page 3-2.

☞ A measurement with the wrong probe type is not possible.

↑

- In numeric display mode, an arrow shown pointing upward before the measurement display indicates that this measurement is above the upper limit.

Display Symbols
continued

↓

- In numeric display mode, an arrow shown downward before the measurement display indicates that this measurement is below the lower limit.

#

- In the lists of applications, the applications that have been secured show the "#" character before the name of the application.

*

- Additionally, if the normalization and calibration functions of the secured applications are blocked, the "*" character appears before the name of the application in the list of the applications.

- Application Linking Mode is active. When the Linking Mode is active, the normalization and corrective calibration functions affect all applications which have been set up for the same measuring type and with the same (equal) probe as the active application (current application).

Reference Measurement

6.1.29 Reference Measurement

Check the normalization or calibration of an application at regular intervals. Perform these checks by making reference measurements:

- Measure on a reference part with a known coating thickness (electrical conductivity, or ferrite content).

- Reference parts are parts
  - with properties (geometry, material, permeability, etc.) that correspond to the part of the current (control) measurement application, and
  - with a coating thickness (ferrite content, el. conductivity) close to the production parts which have to be measured accurately,
  - with clearly defined measurement location.

- Perform 20 to 30 measurements on the reference part.

If the measurement of the reference part violate specified tolerances, a new normalization or calibration (corrective or master calibration) will need to be performed.

For more information see Chapter 7.

☞ **Normalization or calibration have to be performed carefully!** They determine the accuracy of the subsequent measurements.

☞ **Do not use the supplied Base material standard as substrate for the reference measurement!** This control piece is only used to monitor the instrument.

☞ Reference parts are subject to **wear** that affects the measurement. Reference parts must be replaced accordingly.

6.2 Description of the Softkeys

Moving the marker (cursor) in entry and selection fields **up.** In numeric display: scrolling through the single readings in the direction of the last block (no. n).	↑
Moving the marker (cursor) in entry and selection fields **down.** In numeric display: scrolling through the single readings in the direction of the first block (no. 1).	↓
Moving the marker (cursor, arrow, line) in entry fields, selection fields and graphs (e.g., in SPC chart display) to the **left.**	←
Moving the marker (cursor, arrow, line) in entry fields, selection fields, and graphs (e.g., in SPC chart display) to the **right.**	→
Select the Calibration or Normalization routine according to the available standards - applies to BETA.	1 2 3 4
Switching pages in SPC Chart display mode for the measuring type SIGMA (DUPLEX). Switch to the page 1, SPC Chart display of the paint coating (non-conductive coating).	1.
Switching pages in SPC Chart display mode for the measuring type SIGMA (DUPLEX). Switch to the page 2, SPC Chart display of the zinc coating, for instance (NF coating).	2.
Evaluation with the normal probability chart. This graphics display of the normal probability chart shows the percentage of the product lot in relation to the measured attribute (coating thickness, electrical conductivity, ferrite content). The vertical (Y) axis probability scale indicates the percentage of product with a coating thickness (for example) that is less than or equal to the corresponding coating thickness value on the horizontal (X) axis. A meaningful product lot analysis must be based on a sufficient number of product sample measurements, a sample lot of no less than 100 items is recommended.	Σ
Enter (pre-set) various parameters for calculating control limits.	ADVAN CED

AUTOM MEAS.	**Start Automatic Measurement Evaluation** (menu function 25, for BETA only).
BLOCK -	**Switch to the Previous Block:** Displays the block result of the previous block.
BLOCK +	**Switch to the Next Block:** Displays the block result of the next block.
BLOCK CONT.	**Continue the Last Closed Block:** additional measurements can still be added to this block; the end of the block is canceled.
BLOCK RES.	**Block Result:** Ends a block, displays the block result, that is, the statistical evaluation of a block (consisting of n single readings) within a measurement series,e.g., of several single readings on one measurement position. The current date and time are stored with every closed block for time reference.
CALC.	**Calculate the measuring time** for the pre-setted measurement uncertainty Fnorm or Fcal of normalization or calibration (menu functions 21 or 22). - For Beta only.
CONFIRM	**Confirm/Save** the entries/selections of a function.
CONTINUE	**Scroll** to the next/previous menu page, changes made remain valid.
COPY	**Copy a Selected Application** (menu function 3).
DEF	**Defining user specified unit** (menu function 12).
DEL	**Delete a selected application** (menu function 4) or **all measurement data of the active application** (menu function 2).
DEL BLOCK	**Delete the Last Open Block:** The block result has not yet been calculated. Can be performed as long as a new application has not yet been called or the instrument has not been switched OFF. These activities call an automatic end of a block (not available with BETA).

Delete a Calibration: in the application memory. The corrective calibration of the active application stored in the application memory will be deleted. ☝ **When the Application Linking Mode is active** the corrective calibrations of which are linked with the active application all applications will be deleted.	DEL CAL
Delete the selected feature from the active application (menu function 6).	DEL FEAT.
Delete all measurement data of the active application in the simple operating mode..	DEL MEAS.
Quit (cancel) **the master calibration for dual coatings** (SIGMA (DUPLEX)).	END
Confirm the selected character in the entry box.	ENTER CHAR.
Opens the entry field to enter the standard value.	ENTER STD
Cancel the Function: Switch to the current measurement mode, changes will not be saved/accepted.	ESCAPE
Switch to Evaluation Menu: Select the desired presentation mode: SPC Chart, Histogram, Probability Chart, Statistical Evaluation. ☞ Switching to the evaluation menu automatically closes a block. If automatic block result has been selected for current application, the last measurements of an open block will be deleted when switching to the evaluation menu.	EVALUATE
Final Result: Evaluation over all blocks of the active application (in the simple operating mode).	FINAL RES.
SPC Chart presentation; **accepting the values from the pre-run** to calculate the control limits.	FORERUN
Turns the continuous display update (free) measurement mode off. (Continuous display update mode switched on in menu function 9).	FREE OFF
Measure in air: probe in air. **Accept the measurement in air.**	GET Xs

HISTO GRAM	**Histogram Display** (frequency distribution): Graphical presentation of the single readings (minimum of 10) of a test series (application) classified by coating thickness ranges for example.
INFO C_p	**Information About the Statistical Parameters of the SPC Chart:** statistical evaluation with mean value, standard deviation, and range of measurement data of a selected block (subgroup).
INPUT FEAT.	**Changing the name of the feature** that has already been assigned to a block.
INPUT Std 1	**Open the entry box to enter the value of the first standard**.
INPUT Std 2	**Open the entry box to enter the value of the second standard.**
INPUT Std 3	**Open the entry box to enter the value of the third standard.**
INPUT Std 4	**Open the entry box to enter the fourth standard**.
INPUT Xo	**Open the entry box to enter the countrate of the substrate** - when using the BETA.
INPUT Xs	**Open the entry box to enter the countrate of the saturation coating** - when using the BETA.
INTER VALS	Open a menu page to **display the range of the Xn intervals** for the standards. The readings of the standards have to be within specific intervals to get a proper calibration characteristic. **Exception:** no softkey function for measuring type SIGMASCOPE®.
MAGNA	**MAGNA**: With the duplex probe, the calibration for the master calibration needs to be performed separately for both coating materials. Use MAGNA to start the **calibration routine for the non-conductive coating on a steel substrate (NC/Fe)**. (Use PHASE for the nonmagnetic coating on a steel substrate).
MEAS RANGE	**Displays the measurement range** instead of the probe type **in the list of applications.**

Redetermines the number of measurements above and below the changed Upper Control Limit (UCL), or Lower Control Limit (LCL) respectively. This becomes necessary when the Control Limits (UCL, LCL) for an existing application with stored measurement data are changed.	NEW
New measurement series, deletes the current measurement series set up in the calibration and normalization functions.	NEW BLOCK
Assigns a new feature to an already finished block.	NEW FEAT.
New probe: **Assigning a new probe** (of the same type) **to an application**, since the probe used to set up the application initially is defective, worn, or lost (menu function 32).	NEW PROBE
Open a window to **Enter the Offset** Value (Correction Value).	OFF- SET
ON/OFF: Enable/Disable switch **for parameters**.	ON OFF
Scroll to next/previous menu page, or display additional softkey functions.	PAGE
Page up to the previous menu page.	PAGE ↑
Page down to the next menu page.	PAGE ↓
Enter/Select the SPC Parameters.	PARA- METER
PHASE: With the duplex probe, the master calibration needs to be performed separately for both coating materials. Use PHASE to start the **calibration routine for the non-magnetic coating on a steel substrate (NF/Fe)**. (Use MAGNA for the non-conductive coating on an iron substrate).	PHASE
Measurement data and statistical evaluation output to printer: for numeric, specification limit, and SPC Chart display according to the settings made in menu function 10.	PRINT

PRINT ALL	**Printout of all measurement data of all test points of every specimen** - for the difference measurement.
PRINT HEAD	**Selection and printing of print header** is done from the evaluation menu, second menu page.
PRINT MPOS.	**Printout of all measurement data of a selected test point of a selected specimen** - for the difference measurement.
PRINT SPEC.	**Printout of all measurement data of all test points of a selected specimen** - for the difference measurement.
PROBE TYPE	**Displays the probe type** instead of the measurement range **in the list of applications.**
REPEAT	**Deletes the measurement data of the last measurement series** for a repeat measurement (calibration function).
RETURN	**Scroll** to the previous menu page.
RHO = 1	**Reset the density factor** (Rho) to 1 - applies to BETA.
RS-232	**Output of measurement data and the statistical evaluation via the RS232 interface** according to the settings in menu function 13.
SECURE	**Secure a selected application** (a kind of write protection).
STABI TEST	**Start the stability test** (menu function 25) - applies to BETA.
SPC CHART	**Evaluation using the Statistical Process Control Method** (**SPC Chart**), for quality control and process control. Ability to print the graphical measurement data display. Also for measurements with numeric and specification limit display. For SPC control chart evaluation in these two measurement display modes, the block sizes (fixed number of readings per block) are determined by selection of the N parameter - the default setting is 5. To change this setting, call the menu page with the SPC parameters using the softkey PARAMETER and enter the desired value under N.

☞ Please note that for larger blocks (number of measurements higher than the setting under N), only integer multiples of N measurements are used for the SPC control chart display and evaluation, and the remaining data of the block are ignored! For example: 18 measurements form a block, N = 5. For SPC control chart display, this block is divided into 3 SPC blocks of 5 measurements each and displayed, while the remaining three measurement data are ignored.

Upper and Lower Control Limits can be set using the softkey PARAMETER (see Chapter 5, Section "SPC Chart").

START

Measurement Start when using the BETA method.

☞ Measurement can also be initiated using the GO key on the measuring table. Press the GO key again to cancel the measurement.

START MEAS.

Measurement Start in the calibration function when using the BETA method.

☞ Measurement can also be initiated using the GO key on the measuring table. Press the GO key again to cancel the measurement.

STAT.

Statistical evaluation of the test series (application), mean value, standard deviation, coefficient of variation, etc.

☞ The mean values of the individual blocks are used for the statistical evaluation for SPC chart measurement and when activating "automatic Batch Result".

Tcal Ncal

Switch to the menu page for **entering the time and the number of measurements for the calibration** (in the calibration function) - applies to BETA.

TEMP. ALPHA

Open a menu page to enter the **temperature** and the **temperature coefficient** for the electrical conductivity measurement with temperature correction.

Tnorm Nnorm

Switch to the menu page for **entering the time and the number of measurements for the normalization** (in the normalization function) - applies to BETA.

TEMP.

SIGMASCOPE®: **Enter the "Sensor temperature" as the specimen temperature** ("Current temp.") with the softkey TEMP. Possible only if the optional surface temperature probe is connected to the MMS® (MULTIFUNCTION socket) and if the sensor is used to measure the surface temperature of the specimen ("Sensor temperature").

TO COATG

Switch to the next coating at the same test point and same specimen - for the difference measurement.

TO SPEC.	**Switch to the next coating specimen** - for the difference measurement.
TO MPOS.	**Switch to the next test point on the same sample** - for the difference measurement.
UN SEC.	**Unsecure the application** (Menu Function 33 in the Supervisor Menu (29)).

6.3 Description of the Menu Functions

Menu Function Overview

No.	Measuring Type Menu Function	PERMASCOPE®	ISOSCOPE®	DUALSCOPE®	BETA	SIGMA	NICKELSCOPE®	CU-SCOPE	FERITSCOPE®	SIGMASCOPE®	FISCHERSCOPE®	Page
0	Set Up New Application	●	●	●	●	●	●	●	●	●	●	6-45
1	Change Application	●	●	●	●	●	●	●	●	●	●	6-48
2	Delete Appl. Measurement Data	●	●	●	●	●	●	●	●	●	●	6-50
3	Copy Application	●	●	●	●	●	●	●	●	●	●	6-51
4	Delete Application	●	●	●	●	●	●	●	●	●	●	6-52
5	Del./Accept Meas. Data Block	●	●	●	●	●	●	●	●	●	●	6-53
6	Select Feature	●	●	●	●	●	●	●	●	●	●	6-54
7	Change Feature	●	●	●	●	●	●	●	●	●	●	6-56
8	Beep ON/OFF	●	●	●	●	●	●	●	●	●	●	6-57
9	Select Free Display Mode	●	●	●	-	●	●	●	●	●	-	6-58
10	Output to Printer	●	●	●	●	●	●	●	●	●	●	6-59
11	Set Date/Time	●	●	●	●	●	●	●	●	●	●	6-60
12	Select Units	●	●	●	●	●	●	●	●	●	●	6-61
13	Output to Serial Port	●	●	●	●	●	●	●	●	●	●	6-63
14	Calibration on Coating	●	-	-	-	-	-	-	-	-	-	6-64
	Standards for Master Calib.	-	-	-	-	-	-	-	-	●	-	6-65
15	Master Calibration	●	●	●	-	●	●	●	●	●	-	6-66
	Enter Density	-	-	-	●	-	-	-	-	-	-	6-67
16	Instrument Status	●	●	●	●	●	●	●	●	●	●	6-68
17	Adjust Brightness	●	●	●	●	●	●	●	●	●	●	6-69
18	Disp. Mode/Meas. Trigger	●	●	●	●	●	●	●	●	●	-	6-70
19	Display Resolution	●	●	●	●	●	●	●	●	●	●	6-73
20	Measurement Time Calculation	-	-	-	●	-	-	-	-	-	-	6-74
	Enter Board Thickness	-	-	-	-	-	-	●	-	-	-	6-75

● Function can be executed, ○ Function cannot be executed
- Function not available for this measuring type

No.	Measuring Type / Menu Function	PERMASCOPE®	ISOSCOPE®	DUALSCOPE®	BETA	SIGMA	NICKELSCOPE®	CU-SCOPE	FERITSCOPE®	SIGMASCOPE®	FISCHERSCOPE®	Page
21	Normalization to Pre-set F_{norm}	-	-	-	●	-	-	-	-	-	-	6-76
	Temperature Calibration	-	-	-	-	-	-	-	-	●	-	6-76
	Enter Correction Factor	-	-	-	-	-	-	●	-	-	-	6-79
22	Calibration to Pre-set F_{cal}	-	-	-	●	-	-	-	-	-	-	6-80
	Probe Sensitivity	-	-	-	-	-	-	●	-	-	-	6-82
23	Normalization without X_s	-	-	-	●	-	-	-	-	-	-	6-83
24	Info for Last Measurement	-	-	-	●	-	-	-	-	-	-	6-84
25	Automatic Measurement	-	-	-	●	-	-	-	-	-	-	6-85
28	Store / Do Not Store Readings	●	●	●	●	●	●	●	●	●	●	6-87
29	Supervisor-Menu	●	●	●	●	●	●	●	●	●	●	6-88
29 30	Printer Selection	●	●	●	●	●	●	●	●	●	●	6-89
29 31	Serial Port Configuration	●	●	●	●	●	●	●	●	●	●	6-90
29 32	Assign New Probe	●	●	●	○	●	●	●	●	●	-	6-91
29 33	Secure/Unsecure Application	●	●	●	●	●	●	●	●	●	●	6-93
29 34	Simple/Normal Mode	●	●	●	●	●	●	●	●	●	●	6-95
29 35	Automatic Switch-OFF	●	●	●	●	●	●	●	●	●	●	6-97
29 36	Lift-Off-Compensation	-	-	-	-	○	-	-	-	○	-	6-98
	Set DUAL Method	-	-	●	-	-	-	-	-	-	-	6-98
29 37	Linking of applications	●	●	●	-	●	●	●	●	●	-	6-100
29 38	Control Line Level	●	●	●	●	●	●	●	●	●	●	6-102
29 39	Calculation of control limits	●	●	●	●	●	●	●	●	●	●	6-103
29 40	Allow adapter 19/8	●	●	●	-	-	-	-	-	-	-	6-104

● Function can be executed, ○ Function cannot be executed

\- Function not available for this measuring type

0 Set Up New Application

0 Set Up New Application

A memory to store the probe in use and the parameters for a certain application is defined when a new application is set up. All necessary settings of an application can be defined on 7 (or 8) menu pages.

Procedure

- Call menu function 0, 'Set Up New Application':

  Press **0** and then the **MENU** key.

  📖 See also Section 'Calling a Menu Function', Page 6-12.

- Use the keypad (**0** ... **9**) to enter the number for the application and confirm it with **ENTER** (menu page 1).

- Select the desired probe (menu page 2):

  Use softkeys ↑ / ↓.

- Confirm the probe selection by pressing the softkey **CON-FIRM**.

- Enter the name for the new application (menu page 3). You can use a maximum of 10 characters from the character field on the right. Use the arrow keys of the keypad (**▼2**, **◀4**, **6▶**, **▲8**) to select the characters for the name. Accept the name into the entry box with the softkey **ENTER CHAR.** .

  📖 On how to enter alphanumeric characters see Page 6-24.

- Enter/select parameters (menu pages 4 to 7 (8)):

  Use the softkey **PAGE** to scroll through the menu pages.

  Use softkeys ↑ and ↓ to move the cursor (dot/rectangle) to select a parameter.

  Use the **ENTER** key to move the cursor between the individual parameters or windows.

  📖 See also pages 6-26 and 6-27.

  📖 For a description of the parameters see Appendix B.

  📖 For examples on how to set up a new application see Chapter 4.

- Normalization (Calibration for BETA)

  Once the settings are done, use the softkey **CON-TINUE** to switch to the normalization routine (calibration routine). Follow the instruction on the display to move through the normalization or calibration routine. 📖 See also Chapter 7.

0 Set Up New Application
(continued)

- Store settings and normalization/calibration as a new application:

  Press softkey **CON-FIRM** to store all settings and the normalization/calibration as a new application under the number listed and the application name entered. Switch to the measuring mode of the new application.

☞ A new application cannot be set up from a **secured application**!

☞ The MMS® **cannot** be switched OFF while setting up an application.

☞ **Unit of measurement** settings for the new application are automatically accepted from the active application. These settings can be viewed and changed in menu function 12. ▤ See description of Function "12 Select Units of Measurement" on page 6-61.

☞ **Dual probe** (z. B. ED10): See also function 36 "set DUAL Method", description on page 6-98.

Outlier Rejection

This function can be used to reject measurements which are not consistent and statistically not compatible with the measurement variability of the current measurement series. By rejecting outlier measurements the statistical evaluation of a measurement series will not be unjustifiably biased. The MMS® offers two different methods of outlier rejection:
Automatic: This method identifies outlier measurements based on a statistical test (Grubbs test) at a statistical confidence level of
P = 90 %.
Sigma known: If the standard deviation (Sigma of the measurement distribution is known the Sigma value can be used to identify outlier measurements at a confidence level of P = 99.9 %. A reasonably secure estimate of Sigma must be known and it should be based on a sufficiently large number of measurements. For this purpose a trial measurement series of no less than N = 100 measurements is recommended. Furthermore the assumption must be made that Sigma does not change significantly with each new measurement series. If this assumption can be justified then outlier measurements can be readily identified.

Because during a measurement series the mean value ($\overline{th}$), the number of measurements n and the measured standard deviation (s) can change it is possible that a previous measurement in the open block (which was not identified as an outlier measurement in real time) will be identified as an outlier measurement after the measurement was made. This measurement is not used in the subsequent (automatic) outlier rejection criteria calculation.

☞ Outlier rejection is performed within the current open block (batch) only.

☞ Every measurement is immediately tested in real time for outlier criteria.

0 Set Up New Application
(continued)

☞ Outlier measurements are not used in the statistical evaluation of the measurement series.

```
! n = 17        1.80 mils
```

☞ If an outlier measurement is encountered, an acoustical signal is sounded (double beep) and the outlier measurement is is shown with an exclamation mark in the display:! The audible signal cannot be switched OFF regardless of the setting in menu function 8 'Beep ON/OFF'.

```
! n = 17        1.80 mils
 Too many outliers
```

Fig. 6_1: Message if more than two outlier measurements are found

☞ If more than two outlier measurements are found in the open block (batch), the message you see in Figure 6_1 is shown in the display. This comment is intended to alert the user to a possible problem with the measurement series or the test specimen.

☞ Example of measurement hardcopy to printer:

```
   n = 23      0.50 mils
 ! n = 17      1.80 mils
```

In the above example the 17th measurement within the block was recognized as an outlier measurement in automatic outlier rejection mode after the 23 rd measurement was made.

☞ Example of stored measurement data dump to printer:

```
n = 16        0.50 mils
n = 18        0.54 mils
n = 19        0.49 mils
```

Note: Outlier measurements are not shown !

☞ If measurements are subsequently deleted from a block a new automatic outlier test based on the remaining measurements in the block is not made.

1 Change Application

1 Change Application

As with menu function 0, definitions of an application can be changed in 5 (or 8) menu pages.

Procedure

- Call the application to be changed:
  Use the keypad to enter the application number (0 ... 9) and then press APPL.

  📖 See also Section 'Calling an Application', Page 6-6.

- Call menu function 1 'Change Application':

  Press 1 and then the MENU key.

- Change entries/selections:
  You can now perform changes on several menu pages.

  Use softkey PAGE to scroll through the menu pages.

  Use softkeys ↑ and ↓ to move the cursor (dot, rectangle) to select a parameter.

  Use the ENTER key to move the cursor between individual parameters or windows.

  📖 See also pages 6-26 and 6-27.
  📖 See the Section on "El. Conductivity Measurement" (temperature, temperature coefficient α) in Chapter 9 for more information on temperature compensation.

- Save changes for the application:
  When the desired changes for all menu pages have been performed, use softkey CON-FIRM to save the changes. You can save the changes from any menu page. Switch to the measuring mode of the application.

☞ The **menu function 'Change Application'** should be performed **prior to the measurement**. The changes apply only to the subsequent measurement or may only be performed for empty applications (without measurement data).

☞ **Switching** from **numeric display to specification limit display** and vice versa can be done without problems.

☝ The display mode with SPC chart **must be selected before making the first measurement** with the newly defined application. Already existing measurement series (= measurement data) of an application will be deleted upon such a change!

1 Change Application
(continued)

☝ The **difference measurement must be selected before** making the first measurement with the newly defined application. Already existing measurement series (= measurement data) of an application will be deleted upon such a change!

☝ When **monitoring outlier measurements**, the outliers are not entered into the statistical evaluation. They are visually indicated with an '!' and audibly with a double beep (2 signal sounds at short intervals). The audible signal cannot be switched OFF regardless of the setting in menu function 8 'Beep ON/OFF'. 🗐 For greater detail see page 6-46.

☝ The **automatic block result** function can be activated only for empty applications (applications without measurement data). This function cannot be selected, if measurement data are present in the application.

☞ You cannot change **secured applications**. A display message will alert you to this fact.

☞ **Deletion of print headers:** A print header may be deleted from the menu page "Report Selection". First select the print header to be deleted, then use the DEL key to make the deletion. 🗐 Also refer to the section "Deleting a Print Header" on page 6-31.

☞ **BETA:** If the density needs to be corrected, and the **density factor is not known,** the density values for the standard and coating materials can be entered in menu function 15. The MMS® will calculate the density factor automatically. 🗐 See also page 6-67.
All measurement data of this application must be deleted **to change the measurement time** (T_{meas}).

☞ **Dual probe** (z. B. ED10): See also function 36 "set DUAL Method", description on page 6-98.

2 Delete Appl. Measurement Data

2 Delete Appl Measurement Data

Delete all measurement data of an active application - including the blocks.

Procedure

- Call the menu function containing the measurement data to be deleted:

  Use the keypad to enter the application number (0 ... 9) and then press APPL.

  See also Section 'Calling an Application', page 6-6.

- Call menu function 2 'Delete Appl. Measurement Data':

  Press ▼2 and then the MENU key.
  The message: WARNING! All measurement data of this application will be deleted!

- Use the softkey DEL to start the deletion process.

☞ Use the softkey ES-CAPE **to cancel the delete function.** The measurement data of the active application will not be deleted. You will exit this menu function and the measuring mode of the active application will appear on the display.

☞ **Only** measurement data of the **active application** can be deleted with this menu function.

☞ This menu function may also be used to delete the measurement data of an open block. Initiate the delete process using softkey DEL BLOCK. See also Section "Deleting a Block", page 6-18.

3 Copy Application

3 Copy Application

All settings, normalization characteristics, etc. of an application will be copied, but not the measurement data. Thus, copying refers to the application-specific parameters: probe type, characteristic, normalization, calibration, feature, measurement display mode, etc.

Procedure

- Call menu function 3 'Copy Application':

  Press 3 and then the MENU key.

  🕮 See also Section 'Calling a Menu Function', Page 6-12.

- Use the keypad to enter the number of the application to be copied (source) (0 ... 9). The number can be selected from the displayed list.

- Confirm the entry with ENTER.

- Use the keypad to enter the number for the copied application (target) (0 ... 9). An available application number can be selected from the displayed list (number without adjacent text).

- Confirm the entry with ENTER .

- Enter the new name for the copy of the application.
  You can use a maximum of 10 characters from the character field on the right.
  Use the arrow keys of the keypad (▼2, ◀4, 6▶, ▲8) to select the characters for the name. Accept the name into the entry box with the softkey ENTER CHAR. .

  🕮 On how to enter alphanumeric characters see Page 6-24.

- Use the softkey COPY to start copying. Switch to the measuring mode of the active application.

☞ The measurement data will **not** be copied!

☞ All applications can be used as **copy source**, even secured or currently active applications. The **Copies** can be saved only with an unused application number (memory area).

☞ Use the softkey ES-CAPE **to cancel the copy function.** The application will not be copied. You will exit this menu function and the measuring mode of the active application will appear on the display.

4 Delete Application

4 Delete Application

Delete the entire application, including measurement data and settings (probe type, parameter, measurement display mode, normalization characteristic, etc.).

Procedure

- Call menu function 4 'Delete Application':

  Press ◀4 and then the MENU key.
  📄 See also Section 'Calling a Menu Function', Page 6-12.

⤵

- Use the keypad to enter the number of the application to be deleted (0 ... 9). The number can be selected from the displayed list.

- Confirm the entry with ENTER.

- Use the softkey DEL to start deleting.

  If additional applications are to be deleted, repeat the procedure starting at ⤵ .

⤴

- Use softkey CON-TINUE to exit the delete function. Switch to the measuring mode of the active application.

☞ The currently **active application cannot** be deleted!

☞ You **cannot** delete **secured applications**.

☞ Use the softkey ES-CAPE **to cancel the delete function**. The procedure will not be performed. The application list will again appear on the display. You can re-select the application to be deleted. Use softkey CON-TINUE to exit the delete function # 4. Switch to the measuring mode of the active application.

5 Clear/Accept Meas. Data Block

5 Delete/Accept Meas. Data Block

Clear all measurement data of an application block (of a group of measurements). Use this menu function to clear the measurement data from the display only. The measurement data remain safe in the memory. A block "deleted" in this manner is in a sense locked.

Procedure

Clear Block

- Call the application with the block (blocks) to be cleared: Use the keypad to enter the application number (**0** ... **9**) and press **APPL**.

  📄 See also Section 'Calling an Application', Page 6-6.

- Call menu function 5 'Del./Accept Meas. Data Block':

  Press **5** and then the **MENU** key.

- ➩ Select the desired block: use softkeys ↑ and ↓ respectively **PAGE ↑** and **PAGE ↓**.

- ⇦ Use the **DEL** key to 'delete' the block. For the deleted block, periods will appear on the display in place of the block mean value ($\overline{d}$, σ., $\overline{fe}$) and the standard deviation (s).

  If additional blocks are to be cleared, repeat the procedure starting at ➩ .

- Use the softkey **CON-TINUE** to exit this menu function. Switch to the measuring mode of the active application.

☞ The block number remains safe and the **measurement data** of the cleared block **cannot** be overwritten.

☞ For **applications with dual coatings** (Duplex), only the block mean value and the standard deviation of one coating (top, 1) will be displayed.

☞ This menu function is not available for **difference measurement** applications. For such measurements, this function is removed from the menu function overview.

☞ This menu function cannot be executed with **secured applications**.

5 Delete/Accept Block (continued)

Display the Block

Re-display Cleared Block is possible since the data were not permanently erased during the deletion process (see before).

- Call the desired application, then call menu function 5 'Delete/Accept Meas. Data Block' as described before.

- Select the block to be re-displayed from menu function 5:

  Use softkeys ↑, ↓ respectively PAGE ↑ and PAGE ↓ (periods replace $\overline{d}$- (σ.-, $\overline{fe}$-) and s values of a cleared block).

- Press the DEL key in menu function 5 again to undo the clearing of the block.

6 Select Feature

6 Select Feature

A feature can be assigned to every block (measurement series) of an application. The feature is additional information that is user-defined and consists of a maximum of 5 alphanumeric characters. Features are assigned to the blocks together with the respective block ending.

Procedure

- Call the application, where features are to be assigned to the blocks during measurement:

  Use the keypad to enter the application number (0 ... 9) and press APPL.

  🗐 See also Section 'Calling an Application', page 6-6.

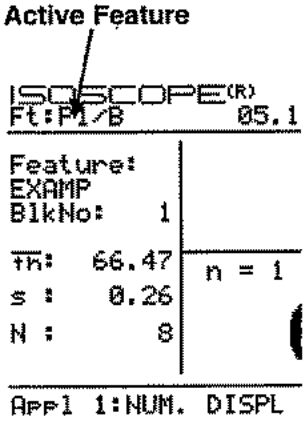
- Call menu function 6 'Select Feature':

  Press 6▶ and then the MENU key.

- Select the desired feature: use softkeys ↑ and ↓.

6 Select Feature
(continued)

- Use the softkey **CON-FIRM** to accept the selected feature into the measuring mode of the active application. Switch to the measuring mode of the active application. The selected feature (= active feature) will appear in the upper left corner of the display under the measuring type (Example: Ft: P1/B). The selected feature will be assigned to the when the block is closed.



```
ISOSCOPE(R)
Ft:P1/B         05.1
Feature:
EXAMP
BlkNo:    1
x̄:     66.47   n = 1
s :     0.26
N :        8
Appl  1:NUM. DISPL
```

☞ A feature selected in menu function #6 **cannot** be assigned to a **finished block**!

☞ Call menu function 6 and **select the feature** prior to or during a measurement series (block).

☞ The last selected feature assigned to a block (finished) is always active for an **open block** (measurement series not finished).

☞ For an **example** on how to define/assign features see Chapter 4, Example 2 on page 4-10.

☞ The current date and time are stored with every **finished block** for time reference.

☞ In the **evaluation menu**, all blocks with the same feature can be combined for an evaluation.

☞ The feature **selection list** is available to all applications. However, a feature can only be **assigned** to the active application.

☞ **Define/Change Features** is covered in menu function 7 'Change Feature'. See the next page for a description.

Delete Feature

Delete Feature

This refers to deleting a selected feature from the measuring mode of the active application - and not to a deletion of the feature itself. Press softkey **DEL FEAT** and the feature selected in menu function 6 is no longer active in the measuring mode of the selected application. The display will no longer show the feature under "Ft:".

7 Change Feature

7 Change Feature

The feature is additional information that is user-defined and can be assigned to an application block. For instance, block selection for a statistical evaluation can be performed by features. A feature consists of a maximum of 5 alphanumeric characters. A maximum of 10 features can be specified (changed) in an instrument. Ft1 to Ft10 serve as default labels on the menu page.

A feature may be a name, order number, batch name, etc. or may designate a certain area, or other characteristic of the test specimen. Examples: door, cover, hood, etc.

Procedure

- Call menu function 7 'Change Feature':

  Press **7** and then the **MENU** key.
  📖 See also Section 'Calling a Menu Function', page 6-12.

➩

- Select the desired feature or the desired default label:

  use softkeys **↑** and **↓**.

- Confirm the selection with the **ENTER** key of the keypad.
  A character field with all characters available to enter features appears in the right half of the display.

  Use the arrow keys of the keypad (**▼2**, **◀4**, **6▶**, **▲8**) to select the character for the feature. Accept the selection into the entry field using the softkey **ENTER CHAR.**.

  Press the **ON OFF** key for switching between upper and lower case in the character field.
  📖 On how to enter alphanumeric characters see page 6-24.

- Confirm the name of the feature with the **ENTER** key of the keypad.
  The feature name entered will appear replacing the selected default label. The character field in the right half of the display disappears.

  ⇦ To define or change additional features repeat the procedure starting at ➩.

- Use the softkey **CON-FIRM** to save the defined features. Switch to the measuring mode of the active application.

☞ Feature defined in menu function 7 are available for all applications (blocks).

☞ In menu function 7, features are not **assigned** to the current block of the active application. Assigning the feature to a block is done in menu function 6, see page 6-54

7 Change feature
(continued)

☞ **Changed features** apply only to future assignments. The 'old' feature remains unchanged in the applications it was used in.

☞ An **example** on how to define and assign features can be found in Chapter 4, Example 2 on page 4-10.

8 Beep ON/OFF

8 Beep ON/OFF

ON/OFF switch for the signal tone indicating measurement capture. Each measurement data capture can be indicated audibly with a signal tone.

Procedure

- Call menu function 8 'Beep ON/OFF':

  Press **▲8** and then the **MENU** key.
  📄 See also Section 'Calling a Menu Function.', page 6-12.

- Select the desired status (ON or OFF): use the softkeys **↑** and **↓**.

- Use the softkey **CON-FIRM** to confirm and accept the selection. Switch to the measuring mode of the active application.

☞ The settings of menu function 8 apply to **all applications**. The setting of this function can be changed at any time.

☞ Use the softkey **ES-CAPE** **to cancel menu function 8** . Changes made to the setting will not go into effect You will exit this menu function and the measuring mode of the active application will appear on the display.

☞ In addition to the acoustic signal during measurement capture other **acoustic signals** may sound. For more information see Chapter 5, page 5-3.

9 Select Free Display Mode

9 Select Free Display Mode

Use this menu function to switch automatic display lock OFF. Measurements are not captured by placing the probe on the specimen but can be locked by pressing the softkey CON-FIRM.

Procedure

- Call the application that is to be selected for continuous display mode:

  Use the keypad to enter the application number (0 ... 9) and press APPL.

  📖 See also Section 'Calling an Application', page 6-6.

- Call menu function 9 'Select Free Display Mode':

  Press 9 and then the MENU key.

  A dotted line will appear on the display in place of the current measurement.

- Place the probe on the specimen. The continuously changing measurement will appear on the display.

- Use the softkey CON-FIRM to confirm the measurement.

☞ In the free display mode, measurement data are confirmed using the softkey CON-FIRM. If the free display mode is ON, selections made in menu function 18 'Disp. Mode/Meas. Trigger' will be ignored as well.

☞ No functions can be called directly from the measuring mode using the number keys and than the MENU key when the Free Display Mode is ON. Call the menu function or application overview (MENU or APPL keys) to automatically turn the free display mode OFF.

☞ This function is not available for applications with **difference measurement**, **SPC chart**, in connection with **Beta probes** and for **RS232 applications**. For such measurements, this function is removed from the function overview.

Free Display Mode OFF

Free Display Mode OFF

When the continuous display mode is ON, the function of the softkey DEL BLOCK changes to FREE OFF.

- Press the softkey FREE OFF to switch the free display mode OFF.

10 Output to Printer

10 Output to Printer

Select the measurement data and the results of the statistical evaluation to be printed during and after the measurement (no printout, print single readings, print block result, single readings and block result).

Procedure

- Call menu function 10 'Output to Printer':

  Press **1**, then **0** and then the **MENU** key.
  📄 See also Section 'Calling a Menu Function.', page 6-12.

- Select the desired output mode: use the softkeys ↑ and ↓.

- Use the softkey **CON-FIRM** to confirm the selection. Switch to the measuring mode of the active application.

☞ **Output Mode 'Print Single Readings'**: with the printer connected and switched ON, print the single readings directly at the moment of measurement capture. This requires a slower measurement capture rate.

☞ **Output mode "Print Block Result"**: with the printer connected and switched ON, print mean values, standard deviations, range, number of measurements, etc. of the block at every end of a block.

☞ All **single readings** can be printed out together **after measurement capture**.
Start the printout from the evaluation menu using softkey **PRINT**.
In the measuring mode press the following softkeys: **EVAL-UATE**, **PAGE**, **PRINT**.

☞ **The settings of menu function 10** apply to all applications. The function settings can be changed at any time.

☞ When the parameter "print Automatic Evaluation" is activated in menu function 0 or 1 for the current application, the printing of the measurement data will be performed according to the parameter settings in menu function 10 and menu function 0 or 1.

☞ Use the softkey **ES-CAPE** to **cancel menu function 10**. Changes made to the setting will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

11 Set Date/Time

11 Set Date/Time

Set the internal system clock to the current date and time. Define the date and time display formats. You may also select between the European date format: DD/MM/YY and the U.S. format: MM/DD/YY.

Procedure

- Call menu function 11 'Set Date/Time':

  Press 1, then 1 and then the MENU key.

  See also Section 'Calling a Menu Function', page 6-12.

- Enter date and time.

  Use the keypad to enter the numbers, advance the cursor with ENTER.

  Then use softkeys ↑ and ↓ to select the display format. These softkeys will appear when the cursor is in the field (●).

- Use the softkey CON-FIRM to save the settings. Switch to the measuring mode of the active application.

☞ The **internal system clock** is battery-buffered. The battery should last for approx. 8 years.

☞ The **settings of menu function 11** apply to all applications. The function settings can be changed at any time.

☞ Date and time are stored with every end of a block. **Changes in menu function 11** do not apply to these stored data.

☞ Use the softkey ES-CAPE **to cancel menu function 11** Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

12 Select Units

12 Select Units

Select the units of measurement for the various applications.
Coating thickness: metric, Inch or user specified Units,
Electrical conductivity: %IACS or MS/m,
Ferrite content: Fe% or WRC-FN,
Temperature: Celsius (°C) or Fahrenheit (°F).

Procedure

- Call menu function 12 'Select Units':

  Press [1], then [▼2], and then the [MENU] key.
  📄 See also Section 'Calling a Menu Function', Page 6-12.

- Select the desired units:

  Advance the cursor with [ENTER].

  Select the desired display format: Use the softkeys [↑] and [↓].

☞ **User specified unit of measurement** (parameter "define"):

Press softkey [DEF] to open a menu page for the unit conversion factor entry.
📄 See next page for greater details.

- Use the softkey [CON-FIRM] to save the settings. Switch to the measuring mode of the active application.

☞ The **settings in menu function 12** apply to all applications and can be changed at any time. **Exception**: Ferrite content measurement applications.

☞ **User-defined unit** of measurement; applies only to coating thickness measurement and RS232 applications, see next Page.

☞ The unit for **ferrite content measurement** is stored in the Application.

☞ To **switch the unit for ferrite content measurement** from % Fe to FN or vice versa, the active application must have FERITSCOPE® as measuring type. If the application contains measurement data, they must be deleted before switching to a different unit. The display will prompt you to do so.

☞ Use the softkey [ES-CAPE] to **cancel menu function 12**. Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

User-defined Unit of measurement for thickness measurement only

- Press softkey **DEF** to open a menu page for the unit conversion factor entry.

☞ The user specified unit may consists of a maximum of 4 characters.

☞ Use +/- key to switch between upper and lower case.

☞ The user-defined unit of measurement always refers to µm (except for the measurement method BETASCOPE®; see the next section). Example: desired unit of measurement "mm" - conversion factor = 1000 (1 mm = 1000 µm)

☞ A user-defined unit of measurement can only be set up for coating thickness measurements and RS232 applications.

Parameter on the display	Description
`Unit of measurem.`	desired unit of measurement, e.g., "mm", max. 4 characters
`1 unit of meas. =`	conversion factor, max. 6 digits
☝ **All measurement data of all applications that were set up for coating thickness measurements are divided by the conversion factor!**	

... with the BETASCOPE® measurement method

The conversion factor refers to the unit of the calibration standard, here µm is a place holder only, substituting for the unit of the calibration standards that were used.

☝ **All measurement data of all applications that were set up for coating thickness measurements are divided by the conversion factor.**

☝ **If a calibration is performed in µm and the measurement in g/m² or vice versa, a conversion is only possible for one application (conversion factor = 1/density or density), because the density will generally be different for the various applications! This means, when changing the application, the conversion factor should be changed accordingly prior to the measurement!**

☞ The calibration should be performed with standards in g/m² **if measurements are to be made in g/m²**. In this case, the conversion factor is 1 and is, therefore, not critical for the other set up applications.

13 Output to Serial Port

13 Output to Serial Port

Define the output of the measurement data via the RS232-port (no output to RS232, readings without separator, readings with separator, block mean value, block mean value + date, block mean value + date + feature, Mean for i-single readings, separator selection (= special character for end of block recognition for single reading transfer))

Procedure

- Call menu function 13 'Output to Serial Port':

  Press **1**, then **3**, and then the **MENU** key.
  🗐 See also Section 'Calling a Menu Function', Page 6-12.

- Select the desired output format: use the softkeys **↑** and **↓**.

  Move the cursor to the window 'Separator:' with **ENTER**.

  Select the desired separator function: use the softkeys **↑** and **↓**.

- Use the softkey **CON-FIRM** to save the settings. Switch to the measuring mode of the active application.

☞ The settings in menu function 13 apply to all applications and can be changed at any time.

☞ Use the softkey **ES-CAPE** to **cancel menu function 13**. Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

14 Calibration On Coating

PERMASCOPE®
DUALSCOPE®

14 Calibration On Coating

Fitting the calibration curve to the properties of the specimen when an uncoated reference sample is not available.

Prerequisite

- magnetic induction test method (Type EG and EK probes, dual probe NF/Fe).
- the master calibration must conform to the substrate, that is, material properties such as the permeability of the substrate when the master calibration was performed, must be identical to the material properties of the coated specimen.
- calibration foils ≥ 15 µm (0.6 mils) must be used (depending on probe).
- the coating thickness to be measured must be in the bottom quarter of the measuring range of the probe.

Procedure

- Call the application that the calibration on coating is to be performed for:
  Use the keypad to enter the application number (0 ... 9)
  then press the APPL key.
- 🗐 See also Section 'Calling an Application', Page 6-6.
- Call menu function 14 'Calibration on Coating':
  Press 1, then ◀4, and then the MENU key.
- Perform the calibration according to the instructions on the display.
  4 See also Chapter 7, Page 7-33.
  Use the keypad to enter the coating thickness of the standard (calibration foil). Use softkey CON-FIRM to accept the entry.
- Use the softkey CON-FIRM to accept the corrected calibration. Switch to the measuring mode of the active application.

☞ A calibration on coating is possible **only for magnetic induction probes** (models EG*, EK*, dual probes). For more information see Chapter 7, Calibration.

☞ The calibration applies only to the **active application.**
Exception: When the Application Linkage Mode is active, the calibration on coating function affects all applications which have been set up for the same measuring type and with the same (equal) probe as the active application.
🗐 See also Section '37 Linking of application', page 6-100.

☞ Use the softkey ES-CAPE to **cancel menu function 14.** Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

14 Standards for Master Calib. (El. Conductivity Measurement)

A master calibration for the electrical conductivity measurement is performed with 8 standards. To perform the master calibration with temperature compensation, the respective temperature coefficients and conductivity values must be entered for the 8 standards in menu function 14.

See also Chapter 7, Page 7-46.

Procedure

- Call the application to measure the electrical conductivity:
  Use the keypad to enter the application number (0 ... 9)
  then press the APPL key.
  See also Section 'Calling an Application', Page 6-6.

- Call menu function 14 'Master Calibration Standards':
  Press 1, then ◀4, and then the MENU key.
  A list (table) to enter the conductivity values (σ) and temperature coefficients (α) appears.

- Enter the conductivity values and temperature coefficients.

  Use the softkey ON OFF to release the entry line [X], that is, the conductivity and the temperature coefficient can be entered in this line (e.g., 1).

  Move the cursor to the respective coefficients with ENTER .
  Use the keypad to enter the numbers.

- Use the softkey CON-FIRM to save the entries. Switch to the measuring mode of the active application.

☞ Entries in menu function 14 apply to **all applications for electrical conductivity measurements** (SIGMASCOPE®) and can be changed at any time.

☞ Use the softkey ES-CAPE to **cancel menu function 14**. Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

15 Master Calibration

PERMASCOPE®
ISOSCOPE®
DUALSCOPE®
SIGMA
NICKELSCOPE®
CU-SCOPE
FERITSCOPE®
SIGMASCOPE®

15 Master Calibration

Establishing the most accurate full range calibration on the uncoated substrate material.

☝ **It is imperative to be familiar with the Master Calibration instructions in Chapter 7 prior to performing a master calibration!**
For coating thickness measurements: beginning with page 7-35
For electrical conductivity measurements: beginning with page 7-46
For ferrite content measurements: beginning with page 7-54

Procedure

- Call the application for which a master calibration is to be performed: Use the keypad to enter the application number (0 ... 9) and then press the APPL key.
  🗐 See also Section 'Calling an Application', Page 6-6.

- Call menu function 15 'Master Calibration':
  Press 1, then 5 and then the MENU key.

- Perform the calibration according to the instructions on the display.
  🗐 See also Chapter 7, Normalization/Calibration.

  ☞ **Be careful when performing the calibration. It determines the accuracy of the subsequent measurements. - Remember, a measurement can never be more accurate than the calibration itself!**

- Accept the new master calibration: Use softkey CON-FIRM. Switch to the measuring mode of the active application.

☞ The master calibration applies to **all applications** for the specific probe.

☞ To avoid erroneous measurements, the **corrective calibrations** in all applications that have been set up with the probe that is to be master calibrated **will be deleted.**

☞ This menu function is not available for **RS232-applications** and for **applications** that are set up for measurements **with a beta probe** (BETA measuring type). It will not appear in the menu function overview of such an application.

☞ Use the softkey ES-CAPE to **cancel menu function 15.** Measurements already made will be disregarded. You will exit this menu function and the measuring mode of the active application will appear on the display.

15 Enter Density (Beta Method Only)

15 Enter Density

BETA

Use this menu function to correct for density variations of the coating material. With the BETA measuring type, this is necessary if the coating material of the specimen has a density that differs from that of the calibration standard. The MMS® automatically calculates the density factor and takes it into account during the measurement.

$$\textit{Density Factor} = \frac{\textit{Density Coating Calibration Standard}}{\textit{Density Coating Specimen}}$$

Prerequisite

- This menu function can be called only for applications that were set up for the BETA measuring type.
- The densities of the calibration standard and of the coating must be known.

Procedure

- Call the application (using the BETA measuring type) that needs a density correction: Use the keypad to enter the application number (0 ... 9) and then press the APPL key.
  ▤ See also Section 'Calling an Application', Page 6-6.
- Call menu function 15 'Enter Density':
  Press 1, then 5 and then the MENU key.
- Enter the respective density values:
  Use the keypad to enter the numbers (0 ... 9),
  then move to the next entry box with ENTER.
- Calculate the density factor: Press ENTER when the density entries have been made.
- Use softkey CON-FIRM to accept the entries and the calculated density factor. Switch to the measuring mode of the active application.

☞ This menu function can be called from the menu function overview only for applications with the **BETA measuring type** - and only if the application contains no measurement data.

☞ The density correction applies only to the **active application.** All other applications set up in the MMS® will not be affected.

Enter Density
(Continued)

☞ If **only** the **density factor is known**, it can be entered directly on menu page 'PARAMETER Page 1' of menu function 1 'Change Application'. ▤ See Page 6-48.

☞ The **density of the standard coating** can be obtained from the certificate enclosed with the calibration standard set.

☞ The **softkey** RHO = 1 resets the density factor to 1. The old entries will remain in the entry boxes. However, this has no effect since a density correction needs a density factor.

☞ Use the softkey ES-CAPE to **cancel menu function 15**. Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

16 Instrument Status

16 Instrument Status

Use this menu function to display the software version installed, the internal memory allocation, and the instrument components. The instrument parameters may also be printed out (software version, memory allocation, number of measurements, number of result blocks, instrument components, selected printer, printout for single readings, transfer measurements via RS232 port, measurement accept, signal tone, RS232 parameter settings and a list of applications set up complete with number, name, test method, measurements and number of blocks).

Procedure

- The measuring mode of an (any) application must appear on the Display.

- Call menu function 16 'Instrument Status':

  Press 1, then 6▶ and then the MENU key.
  ▤ See also Section 'Calling a Menu Function', Page 6-12.
  A status list will appear on the display.

  Use the softkey PAGE to scroll to the next menu page.

  Use the softkey PRINT to print the instrument parameters.

- Use the softkey CON-TINUE to exit the menu function. Switch to the measuring mode of the active application.

☞ The purpose of this menu function is to check the status and the instrument settings. It does not affect the applications.

17 Adjust Brightness

17 Adjust Brightness

Use this menu function to adjust the brightness and contrast of the display.

Procedure

- Call menu function 17 'Adjust Brightness':

  Press 1, then 7 and then the MENU key.
  🗐 See also Section 'Calling a Menu Function', Page 6-12.

- Make the desired brightness and contrast adjustments:

  Use the softkeys ← and → to make the adjustments. The adjustment will take effect immediately.

- Use the softkey CON-TINUE to exit the menu function. Switch to the measuring mode of the active application.

18 Disp. Mode/Meas. Trigger

18 Disp. Mode/Meas. Trigger

Define the measurement data display mode and the type of measurement capture.

Menu Page 1 "Display Mode":

th: Display of the measurement in the respective unit of measurement. The attribute to be measured can be viewed directly on the display, e.g., 15 mils, 25 % IACS, or 5 FN.

XN: Display of the normalized countrate.
The absolute countrate values X (probe output) can range between Xo and Xs. By applying equation 6_1 , the numeric value for XN is always between 0 and 1. This is called the normalized countrate (normalized probe output signal).

$$XN = \frac{X - X_0}{X_S - X_0} \qquad \text{Equation 6\_1}$$

X: Countrate measured on the coated specimen.
X0: Countrate measured on the uncoated specimen.
Xs: Countrate measured on the specimen with the least saturation coating thickness

The attribute to be measured can be displayed over the normalized countrate as calibration curve. (Fig. 6_2).

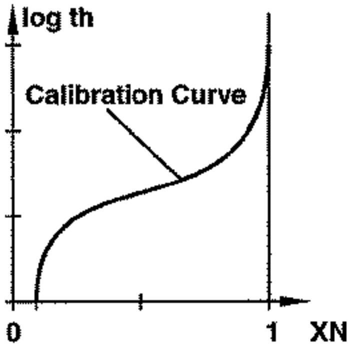


Figure 6_2 Example of a calibration curve for coating thickness

For coating thickness of Zero, the signal XN = 0 and for the saturation thickness the signal XN = 1.

The mid portion of the calibration curve approaches a straight line. This is the range with the smallest relative measurement error. In general, this range will be between XN = 0.35 and 0.85. The normalized countrate is, therefore, ideally suited to determine if a measurement of an application is within this 'optimal' range. Standards for a master calibration must be within certain XN ranges. This can be checked or determined easily by displaying XN.

X: Display of the countrate.
This is the probe signal displayed as the number of electrical impulses. X corresponds directly to the attribute to be measured, that is, the coating thickness, the electrical conductivity, or the ferrite content. The X value will range between the two extremes Xo and Xs. Xo corresponds to a measurement of 0, e.g., th = 0. Xs corresponds to maximum value that can be measured with the probe in use, e.g., coating thickness th = saturation coating thickness, electrical conductivity

18 Disp. Mode/Meas. Trigger
(continued)

σ = 100 % IACS. In general, displaying the countrate X is used to determine if there is a viable measurement signal for a particular measurement application. From the result, it can be determined if another test method might be better suited.

Page 2 "Measurement accept"

by external start only: using an external trigger switch (push button or foot pedal switch) to start measurement acquisition (connected to the EXTERNAL START socket or to pin 4 of the MULTIFUNCTION connector, see also page 3-4) or with the ENTER key of the MMS® keyboard.

by probe signal: automatically when the probe makes contact.

probe sig. + ext. start: automatically when the probe makes contact or using external trigger switch.

auto.meas. (after probe pos.): automatic measurement acquisition while the probe contacts the test specimen surface.

Pause (Seconds): using the MMS® keyboard, enter the time after which a measurement capture is to take place.

[ ] Close block by lift. probe: If this parameter is activated [X], a block will be closed as soon as the probe is lifted off the specimen.

Use the ENTER key to move to the individual parameters.

Procedure

- Call the application for which the display mode or the measurement triggering is to be defined: Use the keypad to enter the application number (0 ... 9) and then press APPL.
  🗐 See also Section 'Calling an Application', Page 6-6.
- Menu function 18 'Disp. Mode/Meas. Trigger':
  Press 1, then ▲8 and then the MENU key.
- Select the desired display mode: use the softkeys ↑ and ↓ to move the cursor inside the selection box.
- Use the PAGE softkey to scroll to the second menu page.
- Select the desired measurement trigger option: use the softkeys ↑ and ↓ to move the cursor inside the selection box.
- Save the settings with the softkey CONFIRM. Switch to the measuring mode of the active application.

18 Disp. Mode/Meas. Trigger (continued)

☞ The settings of menu function 18, menu page 1, **must be selected prior to the first measurement** in an application, i.e., directly after setting up a new application!

☞ Existing measurement data must be deleted, if **the settings for menu function 18, menu page 1,** of an application **are selected later**!

☞ **BETA:** Only menu page 1 "Display Mode" is available for this measuring type. Measurement acquisition by external trigger switch only (ENTER key of the MMS® or GO key at the measuring table).

☞ This menu function is not available for applications receiving their data via the RS232 interface (**RS232 Applications**, measurement method FISCHERSCOPE®).

☞ Use the softkey ESCAPE **to cancel menu function 18.** Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

19 Display Resolution

19 Display Resolution

Select the display resolution. You select the precision of the measurement display - in other words, the number of decimal places. The display resolution can be selected for each application.

Procedure

- Call the application that the new display resolution is to be selected for: Use the keypad to enter the application number (0 ... 9) and press the APPL key.
  🗐 See also Section 'Calling an Application', Page 6-6.

- Call menu function 19 'Display Resolution':
  Press 1, then 9 and then the MENU key.

- Select the desired resolution: Use the softkeys ↑ and ↓.

- Save the selection with the softkey CONFIRM. Switch to the measuring mode of the current application.

☞ Menu function 19 is valid only for the **active application**. All other applications set up in the MMS® will not be affected.

☞ The measurement display resolution for an application **can be selected at a later time.**

☞ Use the softkey ESCAPE to **cancel menu function 19.** Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

20 Measurement Time Calculation

BETA

20 Measurement Time Calculation

Calculate the measuring time T_{meas} for a Beta measurement. The measuring time is calculated as a function of the expected coating thickness and desired measurement precision (c.o.v.).

Procedure

- Call the application (BETA method) for which a new measuring time is to be calculated for: Use the keypad to enter the application number (0 ... 9) and then press APPL..
  📖 See also Section 'Calling an Application', Page 6-6.

- Call menu function 20 'Measurement Time Calculation':
  Press ▼2, then 0 and then the MENU key.

- Enter the expected coating thickness in µm (µinch):
  Use the keypad for the numeric entry (0 ... 9),
  then press ENTER to move to the next entry box.

- Enter the desired coefficient of variation in %:
  Use the keypad for the numeric entry (0 ... 9),

- To calculate the measuring time: Press the softkey CALC..

- Confirm the settings with the softkey CON-FIRM. Switch to the measuring mode of the active application.

☞ This menu function is accessible only from the menu function overview for applications with the **BETA method**.

☞ The measuring time calculation applies only to the **active application**. All other applications set up in the MMS® will not be affected.

☞ The **calculated measuring time** is always a multiple of one second. Small changes to the coefficient of variation entered may be the result. The calculated measuring time is limited to a maximum of 100 sec. If the values entered result in a measuring time of more than 100 sec, then the measuring time will be set to 100 sec and the coefficient of variation will be increased accordingly.

☞ Use the softkey ES-CAPE to **cancel menu function 20**. Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

20 Enter Board Thickness

This menu function is used to enter the thickness of a PC-board where the copper coating thickness of the pated through holes is to be measured. The default setting is 1.5 mm (59 mils).

Procedure

- Call the application (when in measuring type CU-SCOPE) for which the PC-Board thickness is to be entered: Use the keypad to enter the application number 0 ... 9 and then press APPL.

🗐 See also Section "Calling an Application", page 6-6.

- Call menu function 20 'Enter Board Thickness': Press ▼2, the 0 and then the MENU key.

- Enter the desired board thickness in millimeters or mils: use the keyboard to enter the numeric value.

🗐 See also Section 'Entering Numbers', page 6-24.

- Save the settings with the softkey CON-FIRM. Switch to the measuring mode of the active application.

☞ **This menu function** can be called **only for** applications using the **CU-SCOPE measuring type**.

☞ The correction factor entry applies only to the **active application**. It is also taken into consideration for the corrective calibration. 🗐 See Chapter 7, page 7-28.

☞ Use the softkey ES-CAPE to **cancel menu function 20**. Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

20 Enter Board Thickness

CU-SCOPE

21 Normalization to Pre-set Fnorm

BETA

21 Normalization to Pre-set Fnorm

Perform the normalization for a specified measurement uncertainty (Fnorm) for applications with the BETA method. Certain measuring times and a respective number of measurements are required for a normalization to avoid a higher than specified measurement uncertainty. These parameters are calculated with this menu function according to the specified measurement uncertainty.

Procedure

- Call the application (using the BETA method) that the re-normalization to a specified measurement uncertainty is to be performed for: Use the keypad to enter the application number (0 ... 9) and then press APPL.
  See also Section 'Calling an Application', Page 6-6.

- Call menu function 21 'Normalization to Pre-set Fnorm':
  Press ▼2, then 1 and then the MENU key.
  The entry box shows the measurement uncertainty determined or entered at the last normalization.

- Enter the desired measurement uncertainty:
  Use the keypad for the numeric entry (0 ... 9)

- Calculate the measuring time (Tnorm) and the number of measurements (Nnorm) for the new normalization with the pre-set measurement uncertainty: Press the softkey CALC.
  The lower half of the display shows a list with the old (previous) values opposite the newly calculated ones.

- Confirm the settings with the softkey CON-FIRM. Switch to the normalization function.

- Normalize using the new parameters for the specified measurement uncertainty: Follow the display instructions to perform the normalization routine.

- Confirm the settings and save the new normalization parameters into the active application with the softkey CON-FIRM. Switch to the measuring mode of the active application.

21 Normalization to Pre-set Fnorm
(continued)

☞ This menu function is accessible only from the menu function overview for applications with the **BETA method**.

☞ The Normalization to Specified Fnorm applies only to the **active application**. All other applications set up in the MMS® will not be affected.

☞ The **MMS® cannot be switched OFF** during the normalization routine .

☞ Use the softkey ESCAPE to **cancel menu function 21.** Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display. The normalization function will start again with the measurement on the base material (substrate) or on the saturation coating, depending on the moment softkey ESCAPE is pressed during the measurement in the normalization routine.

21 Temperature Calibration

21 Temperature Calibration

SIGMASCOPE®

This menu function is used to calibrate the optional temperature sensor TF100, which can be connected to the multi-function connector.
📖 See Chapter 3, Page 3-4.

The temperature sensor is used for temperature compensation in electr. conductivity measurements. The temperature sensor measures the surface temperature of the specimen and shows the temperature on the display. The reading can be accepted into the instrument. This eliminates the need for a separate temperature instrument. Because of production tolerances or when using a non-Fischer temperature sensor, the factory calibration of the temperature may not fit. In such a case, menu function 21 "Temperature Calibration" offers the possibility to perform a calibration.

Procedure

📖 Call the application (using measurement method SIGMASCOPE®): Enter the application number (0 ... 9) using the keypad and press the APPL key.
📖 See also Section 'Calling an Application', Page 6-6.

- Call menu function 21 'Temperature Calibration': Press the keys ▼2, 1 and MENU (in succession).

- Select, whether the temperature calibration is to be performed at 1 or 2 temperatures. Press the corresponding softkeys: 1 or 2.

☞ Calibrating at 2 temperatures: A minimum temperature difference of 5 °C (41 °F) is required between the two reference temperatures.

21 Temperature Calibration
(continued)

➩

- Place the temperature sensor on an object with a known temperature (reference temperature). The measured temperature appears under "Sensor Temperature:".

- Enter the reference temperature in the entry box "Current Temp.:"

📄 See also the section 'Entering Numbers', Page 6-24.

⬑

- Confirm the entries with the softkey CON-FIRM.
  To calibrate with two temperatures: Repeat the steps for the second reference temperature beginning at ➩ .
  Return to the measurement mode of the current application.

☞ Use the softkey Org Cal. to reset the temperature calibration to the original factory settings.

☞ This menu function can only be called from the menu function overview for applications with the **measurement method SIGMASCOPE®**.

☞ **Cancel menu function 21** with the softkey a. Changes made to the settings will not take effect. You will exit the menu function and the measurement mode of the current application appears on the display.

21 Enter Correction Factor

21 Enter Correction Factor

CU-SCOPE

If it is possible to produce your own PTH calibration standard, the differences (material, temperature) between the Fischer calibration PTH standards and your standard(s) can be corrected by entering a correction factor.

See also Chapter 8, page 8-2.

The correction factor is entered in percent. For instance, if the measurement are 20 % below the nominal thickness, a correction factor of 80 % must be entered to produce the correct measurement.

Procedure

- Call the application (when in measuring type CU-SCOPE) for which a correction factor is to be entered: Use the keypad to enter the application number 0 ... 9 and then press APPL.

  See also Section "Calling an Application", page 6-6.

- Call menu function 21 'Enter Correction Factor': Press ▼2, the 1 and then the MENU key.

- Enter the desired correction factor (in percent): use the keyboard to enter the numeric value.

  See also Section 'Entering Numbers', page 6-24.

- Save the settings with the softkey CON-FIRM. Switch to the measuring mode of the active application.

☞ This menu function can be called **only for applications using the CU-SCOPE measuring type.**

☞ The correction factor entry applies only to the **active application.**

☞ Use the softkey ES-CAPE to **cancel menu function 21.** Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

22 Calibration to Pre-set Fcal

BETA

22 Calibration to Pre-set Fcal

Perform the calibration for a specified measurement uncertainty (Fcal) - for applications with the BETA method. Certain measuring times and a certain number of measurements are required for a calibration to avoid a higher than specified measurement uncertainty. These parameters are calculated with this menu function according to the specified measurement uncertainty.

Procedure

- Call the application (using the BETA method) the re-calibration to a specified measurement uncertainty is to be performed for: Use the keypad to enter the application number (0 ... 9) and then press APPL.
  📄 See also Section 'Calling an Application', Page 6-6.

- Call menu function 22 'Calibration to Pre-set Fcal':
  Press ▼2, then ▼2 and then the MENU key.
  The normalization function opens.

- Perform the normalization routine.

- The normalization parameters are displayed at the end of the normalization. Confirm the parameters with the softkey CON-FIRM. Switch to the next menu page.

- Enter the desired measurement uncertainty:
  Use the keypad for the numeric entry (0 ... 9)

- Calculate the measuring time (Tcal) and the number of measurements (Ncal) for the new calibration with the specified measurement uncertainty: Press the softkey CALC.
  The lower half of the display shows a list with the old (previous) values opposite the newly calculated ones.

- Confirm the settings with the softkey CON-FIRM. Switch to the calibration function.

- Calibrate using the new parameters for the specified measurement uncertainty: number of standards to be used for the calibration. Follow the display instructions to perform the calibration routine.

22 Calibration to Pre-set Fcal (continued)

End the calibration function with the softkey CON-FIRM. The calibration parameters appear on the display.

- Confirm the settings and save the new calibration parameters into the active application with the softkey CON-FIRM. Switch to the measuring mode of the active application.

☞ This menu function is accessible only from the menu function overview for applications with the **BETA method**.

☞ The measurement uncertainty (Fcal) should be specified to between 2 and 5 %.

☞ **Number of Standards** refers to the coated standards that are part of the calibration standard set shipped with the instrument (for example, an Au/Ni calibration standard set contains 1 x Ni Base BCRB (Ni substrate), 1 x Au BCRB (gold coating, saturation coating), 1 x Standard (coated) Au/Ni 2.24 µm BCRB, 1 x Standard (coated) Au/Ni 5.5 µm BCRB, 1 x Standard (coated) Au/Ni 8.5 µm BCRB). The coating thicknesses of the standards depend on the coating thickness range required.

☞ The **Calibration** to Specified Fcal applies only to the **active application**. All other applications set up in the MMS® will not be affected.

☞ The **MMS® cannot be switched OFF** during the calibration routine.

☞ Use the softkey ES-CAPE to **cancel menu function 22**. Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display. The menu function will start again with the measurement on the base material (substrate), on the saturation coating, or on a standard (calibration function only), depending on whether the softkey ES-CAPE is pressed during the normalization or calibration.

22 Probe Sensitivity

CU-SCOPE

22 Probe Sensitivity

The sensitivity of measurement acquisition can be adjusted for the ESL08A probe.
A factor is used to set the probe sensitivity: lowest sensitivity: 8, standard sensitivity: 1.5, highest sensitivity: 0.5
With a sensitivity setting 3, the measurement acquisition for hole diameters < 2 mm (< 80 mils) and copper plating thicknesses in through holes from 6 to 30 µm (0.2 to 1.2 mils).
With standard setting (1.5), a false measurement is triggered when the probe tip touches a flat Cu surface for Cu cladding thickness of approx. 30 µm (1.2 mils). Measurement acquisition for hole diameters < 3.5 mm (< 0.14 ") and copper thicknesses in through holes from 6 to 35 µm (0.2 to 1.4 mils).
With the highest sensitivity (0.5), a false measurement is triggered when the probe tip touches a flat Cu surface starting at a Cu cladding thickness of approx. 5 µm (0.2 mils). Measurement acquisition for hole diameters < 4.5 mm (< 0.18 ") and copper thicknesses in the through holes from 6 to 35 µm (0.2 to 1.4 mils).

Procedure

- Call the application (when in measuring type CU-SCOPE) for which a new probe sensitivity is to be entered: Use the keypad to enter the application number 0 ... 9 and then press APPL.
  🗐 See also Section "Calling an Application", page 6-6.

- Call menu function 22 'Probe sensitivity':
  Press ▼2, the ▼2 and then the MENU key.

- Enter the desired factor for the probe sensitivity: use the keyboard to enter the numeric value.
  🗐 See also Section 'Entering Numbers', page 6-24.

- Save the settings with the softkey CON-FIRM. Switch to the measuring mode of the active application.

☞ This menu function can be called **only for applications using the CU-SCOPE measuring type.**

☞ The sensitivity factor entry applies only to the **active application.**

☞ Use the softkey ES-CAPE to **cancel menu function 22.** Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

23 Normalization without Xs

23 Normalization without Xs

BETA

This function is used to adjust the measuring system to the application, even when it is not possible to measure the saturation thickness of the coating material (e.g., when the pure coating material of saturation thickness is not available). For applications with the BETA method only.

Procedure

- Call the application (using the BETA method) a new normalization without saturation thickness measurement is to be performed for: Use the keypad to enter the application number (0 ... 9) and then press APPL.
  🗐 See also Section 'Calling an Application', Page 6-6.

- Call function 23 'Normalization without Xs':
  Press ▼2, then 3 and then the MENU key.
  The normalization function will open automatically.

- Normalization without prior saturation thickness measurement: Follow the display instructions to perform the normalization routine: Measure on the Base and Standard materials.
  The normalization parameters are displayed automatically at the end of the normalization.

- Confirm the values and save the normalization parameters with the softkey CON-FIRM. Switch to the measuring mode of the active application.

☞ This menu function is accessible only from the menu function overview for applications with the **BETA method**.

☞ The **coating thickness** of the **standard material** should be approximately the same as the one of the expected coating thickness to be measured.

☞ **Normalization** without Xs applies only to the **active application**. All other applications set up in the MMS® will not be affected.

☞ The MMS® **cannot be switched OFF** during the calibration routine.

☞ Use the softkey ES-CAPE to **cancel menu function 23**. Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display. The menu function will start again with the measurement on the base material (substrate), on the saturation coating, or on a standard (calibration function only), depending on when the softkey ES-CAPE is pressed during the normalization or calibration function.

24 Info for Last Measurement

BETA

24 Info For Last Measurement

Use this menu function to view some parameters relative to the last measurement (countrate for the substrate (Xo), saturation countrate of the coating material (Xs), measurement (X); normalized countrate (XN); coating thickness (th); standard deviation (s (x)) of the mean countrate $\overline{X}$ and standard deviation (s ($\overline{th}$)) of the mean coating thickness ($\overline{th}$)). For applications with the BETA method only.

Prerequisites

- Application with BETA method must be active.
- No other application has been called and the instrument has not been switched OFF since the last measurement was taken in the active application.

Procedure

- Call menu function 24 'Info for Last Measurement':

  Press ▼2, then ◄4 and then the MENU key.

  A menu page with various characteristics of the last measurement appears.

- Exit the menu function with the softkey CONTINUE. Switch to the measuring mode of the active application.

☞ This menu function is accessible only from the menu function overview for applications with the **BETA method.**

☞ This menu function serves informational purposes only and has no effect on the active or any other application (if set up).

25 Automatic Measurement

25 Automatic Measurement

BETA

Use this menu function to perform a stability test for the detector or for automatic measurement start.
With an automatic measurement start, the measurement sequence runs automatically according to the specified measuring time Tmeas. That is, a measurement is taken automatically after every x seconds (Tmeas).
The stability test checks the stability of the detector (Geiger-Müller counter tube). Instability can lead to serious measurement fluctuations.

Automatic Measurement Start

Automatic Measurement Start

Procedure

- Call the application (with the BETA method) that an automatic measurement start is to be performed for: Use the keypad to enter the application number (0 ... 9) and then press APPL.
  See also Section 'Calling an Application', Page 6-6.

- Call menu function 25 'Automatic Measurement':
  Press ▼2, then 5 and then the MENU key.

- Activate the 'Automatic Measurement' function with the softkey AUTOM MEAS. .
  In the active application, the measurement data are captured automatically every x seconds (according to the specified measuring time Tmeas).

- The automatic measurement can be **canceled** at any time with the softkey ES-CAPE .

☞ This menu function is accessible only from the menu function overview for applications with the **BETA method.**

☞ The **measuring time Tmeas can** be set/changed from the menu function 1 'Change Application'.

☞ **Automatic Measurement Start applies only to the active application.** All other applications set up in the MMS® will not be affected.

25 Automatic Measurement (continued)

Stability Test

Stability Test

Procedure

- Call a application with the BETA method that was set up with the Beta isotope that the stability test is to be performed for: Use the keypad to enter the application number (0 ... 9) and then press APPL.
  📖 See also Section 'Calling an Application', Page 6-6.

- Call menu function 25 'Automatic Measurement':
  Press ▼2, then 5 and then the MENU key.

- Lower the BETA probe onto the specimen (base, reference part, etc.) or place the specimen on the BETA probe (depending on measuring table, hand probe). The (metallic) material covering the isotope has no influence on the stability test. **It is important that radiation does not emit into the air.**

- Activate the 'Stability Test' function with the softkey STABI TEST .
  An automatic measurement series starts: 50 measurements will be performed with the specified measuring time Tmeas.

- The automatic measurement can be canceled at any time with the softkey ES-CAPE .

☞ This menu function is accessible only from the menu function overview for applications with the **BETA method**.

☞ **Stability Test**: If the test factor is between 0 and 1.5, the stability of the Geiger-Müller counter tube is OK.

☞ This menu function serves only as a test function and **has no effect on the active or any other application** set up in the MMS®.

28 Store / Do Not Store Readings

28 Store / Do Not Store Readings

Use this menu function to define whether for the active application measurement data are to be saved in the application memory. If the selection is: 'Do Not Store meas. data', the simple operating mode display will appear as the measuring mode of the active application. It will show the message "Measurement data not stored ! ! !". This display type will appear regardless of the measurement data presentation mode (numeric display, specification limit display, SPC Chart) selected for the application. 🗐 For a description of the simple operating mode see Chapter 5, Section "Simple Operating Mode".
After selecting "Do Not store meas. data" in this menu function, the readings in the active application will not be saved.

Do Not Save Measurements

Procedure

- Call the application whose measurements are not to be saved: Use the keypad to enter the application number (0 ... 9) and then press APPL.
  🗐 See also Section 'Calling an Application', Page 6-6.

- Call menu function 28 'Store / Do Not Store Readings':
  Press ▼2, then ▲8 and then the MENU key.

- Make the desired selection: Use softkeys ↑ and ↓.

- Use softkey CON-FIRM to save the selection. Switch to the measuring mode ('Simple Operating Mode') of the current application.

Save Measurement Data

Cancel Menu Function 28

Call menu function 28 again and change the selection to 'Store measurement data'.

☞ Menu function 28 applies only to the **active application**. All other applications set up in the MMS will not be affected.

☞ Here, **all menu functions** that can be called with the MENU key **can also be executed**, in contrast to the simple operating mode.

☞ By default, the measurement data are stored in applications.

29 Supervisor-Menu

Supervisor Code : 159

29 Supervisor-Menu

This menu contains functions that are only used in particular instances. They require entry of a supervisor code (= 159) to allow access.

Procedure

Menu functions contained in the Supervisor-Menu can be accessed by either of the following two methods:

If the number of the menu function is known:

- Enter the number (0 ... 9), then press the MENU key, enter the supervisor code (159), and press ENTER.

If the number of the menu function is not known:

- Call the Supervisor-Menu (▼2 9), enter the supervisor code (159), then press ENTER, an overview of all menu functions in the Supervisor-Menu appears, enter the desired number of the menu and press ENTER.

☞ The Supervisor code can not be changed.

☞ If a wrong supervisor code is entered (by pressing a wrong key), the message "--- Wrong Password! ---" will appear on the display. Simply re-enter the supervisor code.

30 Printer Selections

Select the printer type (9-, 24-pin printer, laser printer)

Procedure

- Call menu function 30 'Printer Settings':

  Press **3**, then **0** and then the **MENU** key.

  Enter the supervisor code: **1** **5** **9** (in sequence).

  Press **ENTER** .

  🗐 See also Section 'Calling a Menu Function', Page 6-12.

- Select the desired printer type: use the softkeys ↑ and ↓.

- Use the softkey **CONFIRM** to save the selection. Switch to the measuring mode of the active application.

☞ Menu function "Printer Selections" is accessible only from the Supervisor-Menu!

☞ The **selection of the printer type** is an instrument setting and applies to all applications. The settings can be changed at any time.

☞ The "laser printer" selection will also work for most ink jet printers.

☞ **EPSON STYLUS COLOR printer**: Select the parameter "24-pin printer" for the models 600, 800 and 850. However, a color printout is not possible. The EPSON Stylus Color printer, model 400, is not compatible with the MMS®.

31 Serial Port Configuration

31 Serial Port Configuration

Define the data format for the RS232 interface (baud rate, stop bit, parity, handshake, data bits)
Additionally, the applicable range may be selected:

- the RS232 configuration applies only to the active application,

or

- the RS232 configuration applies to all applications without changing the application-specific settings,

or

- the RS232 configuration is copied into all applications. This means that every application set up in the instrument will have the same RS232 configuration. Current application-specific settings will be overwritten!

Procedure: Setting the configuration

- Call menu function 31 'Serial Port Configuration': Press in sequence 3 1 MENU 1 5 9 ENTER.
- Select the desired configuration: Press ↑ or ↓.

  Move the cursor to the respective selection window: ENTER

Procedure: Setting the applicable range

- Scroll to the second menu page: PAGE.
- Make the desired selection: ↑ or ↓.

☞ Save the same RS232 interface configuration in all applications: Select the parameter "copy current settings" and press the softkey COPY.

- Return to the first menu page: PAGE.
- Save the settings with softkey CON-FIRM. Switch to the measuring mode of the active application.

☞ **The interface configuration of the MMS® and of the connected device (e.g., PC) must be the same. Otherwise, a proper data transfer will not be possible!**

☞ Menu function 'Serial Port Configuration' is accessible only from the Supervisor-Menu!

☞ **The RS232 interface configuration is application-specific** and applies to the open application. The settings can be changed at any time.

☞ **Factory default settings**: baud rate 9600, handshake RTS/CTS, 1 stop bit, no parity, 8 data bits.

32 Assign New Probe

32 Assign New Probe

Use menu function 32 to assign a new probe of the same type to the active application, if the probe that was used to set up this application is defective or worn. The parameters and the measurement data of the application will be preserved. A new application does not need to be assigned to the new probe.

Procedure

- Switch the instrument OFF: Press the OFF key.
- Replace the old probe with the new one.
- Switch the instrument ON: Press the ON key.
- Call menu function 32 'Assign New Probe':

  Press 3, then ▼2 and then the MENU key.

  Enter the supervisor code: 1 5 9 (in sequence).

  Press ENTER.

  🕮 See also Section 'Calling a Menu Function', Page 6-12.

  The name of the active application and the type of the new probe appear on the display.
- Assign the new probe to the active application: Press softkey CON-FIRM. A message will appear on the display.
- Use softkey CON-TINUE to exit menu function 32. Switch to the measuring mode of the active application.
- Perform a normalization with the new probe:

  Call the normalization function: Press the ZERO key. 🕮 See also Chapter 7.
- Measure n times on the Base material until the mean value ($\overline{th}$, Phi, X) changes only slightly or not at all.
- Save the normalization parameters in the active application:

  Press softkey CON-FIRM .

32 Assign New Probe
(continued)

- ☞ **We strongly recommend** to perform a normalization (or calibration) for this application to adapt the calibration curve to the new probe. This will help to avoid errors!
- ☞ Menu function 32 applies only to **the active application** set up. All other applications set up in the MMS® will not be affected.
- ☞ If the MMS® cannot find the **correct probe type** (probe not connected properly), or if the MMS® does not display the correct probe type, unplug the new probe and reconnect it. Then press the softkey NEW PROBE. Please remember that probes for the same test method cannot be connected to the two PERMASCOPE® sockets (e.g., EGAB1.3 and EGAB1.3-Fe are not permitted).
- ☞ Menu function 'Assign New Probe' is accessible only from the supervisor-menu!
- ☞ **BETA:** Menu function 32 cannot be performed with the beta backscatter method. Simply replace the Beta isotope and perform a new calibration for each application that set up for this isotope type.
- ☞ This menu function is not available for applications receiving their data via the RS232 interface (**RS232 Applications**).

33 Secure/Unsecure Application

33 Secure/Unsecure Application

It is not possible to use delete functions (menu function 2, menu function 4, menu function 5) for secured applications. Also, a secured application cannot be edited (menu function 1), the parameters cannot be changed. If so desired, normalization or calibration of a secured application can be blocked as well. All other menu functions, measurement data evaluation and deleting of measurements with the DEL key, or of the last open block (softkey DEL BLOCK), etc. are available.

Procedure

- Call menu function 33 'Secure/Unsecure Application':

  Press 3, then 3 and then the MENU key.

  Enter the supervisor code: 1 5 9 (in sequence).

  Press ENTER .

  📖 See also Section 'Calling a Menu Function', Page 6-12.

☞

Blocking the Normalization and Calibration Functions

- Blocking the normalization and calibration functions (ZERO/ CAL) for this application (if so desired): Press the softkey ON OFF.
- **Unblocking the normalization and calibration functions:** press the softkey ON OFF again.
- Press ENTER to move to the right selection box "Appl.".
- Select the application (name) to be secured/unsecured: use the softkeys ↑ and ↓.

Secure an Application

- Secure the selected application: use the softkey SE-CURE. The following markers will appear to the left of an application name to indicate that the application is secured:

  "*": The application is secured and the normalization and calibration functions are blocked.

  "#": The application is secured, the normalization and calibration functions are still available.

33 Secure/Unsecure Application
(continued)

Unsecure an Application

- Unsecure the selected application (either * or #): use the softkey UN SEC.. The marker to the left of the application name will disappear. It also will no longer appear in the list of applications. The delete and change functions of the application are again available. The normalization and calibration functions of the application are available again as well (if they were blocked (*)).

⇦

- If additional applications are to be secured/unsecured, repeat the sequence starting at ➪ . Use ENTER to switch between the window to activate ZERO and CAL key blocking and the "Appl." window.

- Change to the measuring mode of the active application: use the softkey CON-TINUE.

☞ **Securing and unsecuring** apply only to the application for which the name was selected from the "Appl." list (window) in this menu function.

☞ The menu function 'Secure/Unsecure Application' is accessible only from the Supervisor-Menu!

☞ **Blocking the normalization and corrective calibration functions** [X] takes effect only in connection with securing an application. **Caution:** When the Link Mode is active, the blocking of the normalization or the corrective calibration is ineffective for applications which are linked .

☞ **Secured applications** are marked with a pound sign "#" to the left of the application name.

☞ **Secured applications**, where **additionally** the normalization and calibration functions are blocked, are marked with an asterisk (*) to the left of the application name.

34 Simple/Normal Mode

34 Simple/Normal Mode

Switch between the standard and the limited (simple) operating mode. The simple operating mode does not permit access to menu functions that are called with the MENU key (e.g., setting up applications, setting of parameters, etc.). Measurements are performed strictly according to the selections made when the application was set up. One type of measurement presentation mode is available with the simple operating mode.
🗐 For more information see Chapter 5, Section "Simple Operating Mode", page 5-19.

Procedure

Standard Operating Mode → Simple Operating Mode

- Call menu function 34 'Simple/Normal Mode':

  Press 3, then ◀4 and then the MENU key.

  Enter the supervisor code: 1 5 9 (in sequence).

  Press ENTER.

  🗐 See also Section 'Calling a Menu Function', Page 6-12.

- Select the desired measuring mode: use the softkeys ↑ and ↓.

To delete measurements in the simple measuring mode after pressing the softkey FINAL RES. :

- Press ENTER to move to the next parameter.

- Activate the parameter "Delete measurements with 'FINAL RES'": use the softkey ON OFF.

- Confirm the settings with the softkey CON-FIRM . Change to the simple operating mode of the active application.

34 Simple/Normal Mode
(continued)

Simple Operating Mode → Standard Operating Mode

Switch from simple operating mode to standard operating mode

Procedure

- Press the MENU key. Enter the supervisor code: Press 1, 5, 9 (in sequence) and then ENTER. Menu function 34 will open immediately.
- Use the softkeys ↑ and ↓ to select the normal measurement mode.
- If necessary, deactivate the parameter "Delete measurements with 'FINAL RES.'": Press ENTER and deactivate the parameter with the softkey ON OFF appearing on the display.
- Confirm the settings with the softkey CON-FIRM . Switch to the measuring mode of the active application.

☞ Menu function 34 is a **general setting** that applies to **all** applications.

☞ The **activated parameter** "Delete measurements with 'FINAL RES' " has no effect in the normal measurement mode.

☞ The menu function 'Simple/Normal Mode' is accessible only from the Supervisor-Menu!

☞ **Difference measurement:** Applications with difference measurement cannot be displayed in the simple operating mode. If the simple operating mode is active, an application with difference measurement cannot be called, or menu function 34 cannot be called from an active application with difference measurement.

☞ **To cancel menu function 34** use softkey ES-CAPE. Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

35 Automatic Switch-OFF

35 Automatic Switch-OFF

Use this menu function to set a time period after which the MMS® will switch OFF automatically if no key of the keyboard is pressed, no measurement is carry out, or no data are transferred to the printer or via the RS232 port during this time.

Procedure

- Call menu function 35 'Automatic Switch-OFF':

  Press **3**, then **5** and then the **MENU** key.

  Enter the supervisor code: **1** **5** **9** (in sequence).

  Press **ENTER**.

  📖 See also Section 'Calling a Menu Function', Page 6-12.

- Enter the desired time period: use the number keys of the keypad (**0** ... **9**).

- Save the settings with the softkey **CONFIRM**. Switch to the measuring mode of the active application.

☞ Menu function 35 is a **general instrument setting.**

☞ **Cancel menu function 35** with the softkey **ESCAPE**. Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

36 Lift-Off Compensation

36 Lift-Off Compensation

This menu function is used for compensation the lift-off effect when measuring electr. conductivity, and the coating thickness using the SIGMA measuring type.
The lift-off effect is the effect on the measurement of the air gap, or an outer non-conductive coating, between probe and specimen (up to a certain distance).

For more details on the lift-off effect on electr. conductivity measurements see Chapter 9.

To check the lift-off compensation, see Chapter 7, beginning at page 7-56.

☞ Lift-off compensation is performed exclusively by Fischer or an authorized Fischer service facility.

☞ All probes for the SIGMA (...) and SIGMASCOPE® measuring types are lift-off compensated at the factory. Similar to the master calibration, the lift-off compensation data is stored in the probe connector.

☞ This menu function is not available for applications receiving their data via the RS232 interface (**RS232 Applications**).

36 Set DUAL Method

DUALSCOPE®

36 Specifying the DUAL Measurement Method

Dual probes (e.g., ED10) combine the magnetic induction (PERMASCOPE®) and the eddy current (ISOSCOPE®) measurement methods. These probes are capable of measuring non-magnetic coatings or non-conducting coatings on steel or iron as well as non-conducting coatings on non-ferromagnetic substrate materials. Contrary to the duplex measurement, the dual probe measures only the thickness of one coating.

☞ **Multi-coating system**
The dual probe should only be set up for one measurement method (eddy current, NC/NF or magnetic induction NF/Fe) to make measurements on multi-coating systems. In this case, the dual probe acts either like an eddy current probe (measurement method ISOSCOPE®) or like a magnetic induction probe (measurement method PERMASCOPE®). This ensures that indeed the thickness of the coating of interest will be measured.

36 Set DUAL Method
(contuinued)

non-conductive coating
non-ferromagnetic metal
feromagnetic substrate

Example of a multi-coating system

- **Only non-conducting/NF system active:** in the above example, the thickness of the non-conducting coating can be measured as long as the NF coating has a certain minimum thickness (e.g., 60 µm (2.4 mils) for zinc).
- **Only NF/Fe system active:** in the above example, one coating thickness will be presented that is the sum of the non-conducting coating and the NF coating.
- **Both systems active:** in the above example, either only the thickness of the non-conducting coating (if the NF coating is relatively thick) or the thickness of the non-conducting coating plus the NF coating (if the NF coating is relatively thin) will be measured depending on the thickness and the electrical conductivity of the NF coating.
  Both methods can be used if the measurement method "Both Systems" is selected. The proper measurement method is selected automatically when placing the probe on the specimen.

Procedure

- Call menu function 36 'Set DUAL Method': **3** **6▶** **MENU**.
  Enter the supervisor code: **1** **5** **9** **ENTER** .
- Select the measurement method: **↑**, **↓**.
- Save the setting with the softkey **CON-FIRM**; change to the measurement mode of the current application.

37 Linking of applications

PERMASCOPE®
ISOSCOPE®
DUALSCOPE®
SIGMA
NICKELSCOPE®
CU-SCOPE
FERITSCOPE®
SIGMASCOPE®

37 Linking of Applications

This menu function is used to enable or disable the application linkage mode.
Application linking mode means, linked applications will use the same corrective calibration and the same normalization (Zero function), if and when these functions are performed. This means that the same normalization (Zero) or corrective calibration (cal), when performed, is used by all linked applications for the specific probe and measuring type.

Linking new applications

When new application are created with applications linkage enabled, all linked applications will use the same corrective calibration and the same normalization (Zero function).
For example: All applications created in PERMASCOPE® mode with the EGAB1.3 probe, serial number 0296005, will be linked. The normalization will be setup when creating the first new application. All further new application will automatically use the existing normalization for the specific probe.
A new normalization or corrective calibration will applied for all linked applications.

Linking existing applications

The normalizations and corrective calibrations of the linked applications are different from one another beecause no normalization or corrective calibration was performed in any of the linked applications immediately after enabling the linking mode.
For example: All applications created in PERMASCOPE® mode with the EGAB1.3 probe, serial number 0296005, will be linked. Likewise other multiple applications created for the measuring type NICKELSCOPE® using the probe EN3, serial number 029589, will also be linked. The previous normalizations and calibrations are overwritten.
When new application are created with applications linkage enabled, the new application will automatically use the existing corrective calibration and normalization (Zero) for the specific probe. In this case the normalization is not forced when creating a new application.

Please observe when linking existing applications:

After enabling applications linkage it is important to perform a **new normalization (Zero function) and/or corrective calibration (Cal function)** to assure that all linked applications used a defined calibration or normalization!!!

Procedure

- Call menu function 37 'Linking of applications':

  Press **3**, then **7** and then the **MENU** key.

  Enter the supervisor code: **1** **5** **9** (in sequence).

  Press **ENTER**.

  See also Section 'Calling a Menu Function', Page 6-12.

- Press softkey **ON OFF** to activate the link mode.

- Save the setting with the softkey **CON-FIRM**. Switch to the measuring mode of the active application.

☞ Active (enabled) application linkage mode is indicated by the ⊃O⊂ symbol.

☞ **BETA:** Applications linking is not available for the BETA measuring type.

☞ Menu function 37 is a **global instrument setting** that applies to all applications independent of blocking the normalization and the corrective calibration set in menu function 33. The setting in menu function 37 can be changed at any time.

☞ This menu function is not available for applications receiving their data via the RS232 interface (**RS232 Applications**).

☞ The menu function 'Linking of applications' is accessible only from the Supervisor-Menu!

☞ **Cancel menu function 37** with the softkey **ES-CAPE**. Changes made to the setting will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

37 Linking of applications
(continued)

PERMASCOPE®
ISOSCOPE®
DUALSCOPE®
SIGMA
NICKELSCOPE®
CU-SCOPE
FERITSCOPE®

38 Control Line Level

A control line is connected to pin 12 of the multifunction connector. Its level will switch to high when the data memory (approx. 20,000 measurement data) of the MMS® is full. The control line can be used to control a signal (such as a light, horn, etc.).

🗐 Connector, Chapter 3, Page 3-4.

🗐 Instrument operation (e. g., selecting parameters), from page 6-24 .

☞ The control line has TTL level (5 V/5 mA).

☞ The menu function 38 is a **general instrument setting**.

☞ Use the softkey ESCAPE to **cancel menu function 38**. Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

Procedure

- Call menu function 38 'Control Line Level': 3 ▲8 MENU.
  Enter the supervisor code: 1 5 9 ENTER.
- Select the pin-out: ↑ , ↓.

Displayed Parameter	Description
`normal`	No signal when the data memory of the MMS® is full.
`high, when memory is full`	The line level changes to high, when the data memory of the MMS® is full.

- Use the softkey CONFIRM to save the setting. Switch to the measuring mode of the active application.

39 Select the Calculation Method for the Control Limits

39 Calculation of control limits

Select the standard for calculating the control limits.

- ASTM MNL-7 (ASTM: American Society for Testing and Materials)
- DIN (calculation according to the quality control chart technology of the 'Deutsch Gesellschaft für Qualität e. V.' (German Quality Society))

Instrument operation, e. g., selecting parameters, from page 6-24.

For a parameter description (calculation formulars), see the Glossary in the Appendix.

See also Chapter 11, Evaluation.

Menu function 39 is a **general instrument setting.**

The control limits in the applications will be **re-calculated** when switching from ASTM MNL-7 to "DIN" or vice versa.

Use the softkey ESCAPE to **cancel menu function 39**. Changes made to the settings will not go into effect. You will exit this menu function and the measuring mode of the active application will appear on the display.

Procedure

- Call menu function 39 'Calculation of control limits': 3 9 MENU

  Enter the supervisor code: 1 5 9 ENTER.

- Select the calculation method: ↑, ↓.

- Use the softkey CONFIRM to save the setting. Switch to the measuring mode of the active application.

40 Allow adapter 19/8

PERMASCOP®
ISOSCOPE®
DUALSCOPE®

40 Allow adapter 19/8

Using adapter 19/8 (MMS® X, 602-479) a second magnetic induction or eddy current probe can be connected to the MMS®. Connect one probe to the outer PERMASCOPE® socket and a second probe to the 8-pin socket of the adapter that is plugged into the MAGNA/EDDY socket.

For connection instructions see Chapter 3 Connections, Page 3-5.

On operating the instrument (e.g., parameter selection), see the description earlier in this chapter, from page 6-24.

When using the adapter, a second magnetic induction or eddy current probe may only be connected to the outer, 8-pin PERMASCOPE® socket!

Procedure

- Call menu function 40 'Allow adapter 19/8': ◄4 0 MENU.
  Enter the supervisor code: 1 5 9 ENTER .
- Activate the function: ON OFF.
- Save the setting with the softkey CON-FIRM; change to the measurement mode of the current application.

☞ Set up one (or more) application(s) for each probe.

☞ Menu function 40 is a **general instrument setting.**

☞ You can set up applications or make measurements with magnetic induction or eddy current probes connected via adapter 19/8-Adapter to the MAGNA/EDDY socket only if the adapter has been enabled in menu function 40.

☞ Measurements with probes (e.g., EN3) connected directly to the MAGNA/EDDY socket can be performed even when the menu function 40 is enabled.

☞ **Cancel menu function 40** with the softkey ES-CAPE. Changes made to the settings will not take effect. You will exit the menu function and the measuring mode of the current application will appear on the display.

7 Normalization/Calibration

This chapter deals with systematic influences on the measurement caused by the properties of the specimen and of the probe. These influences can be compensated for by normalization or calibration. The calibration with standards (of a known coating thickness, electrical conductivity or ferrite content) establishes a correlation between the measurement signal and the coating thickness, electrical conductivity, or ferrite content.

Adapting Probe, Instrument, Specimen

The probe stores a master characteristic that corresponds to the standard measurement application for which the probe is designed (exception BETA). By connecting the probe to the instrument, the MMS® loads this characteristic. If the current application deviates from the one defined in the probe, a normalization or corrective calibration can be performed. This adapts the established master characteristic to the properties of the specimen or to the application. By performing a master calibration, a totally new master characteristic can be established.

Types of Calibrations

The differences between the three types of calibration:

Normalization (ZERO ▬)
Basically compensates for geometric changes in the specimen by establishing a new Zero reference value.

Corrective Calibration (CAL ▬)
Used when the normalization is not sufficient to compensate for the influence (e.g., when there are also changes in material properties).

Master Calibration
Setting probe and instrument to a new default condition.

BETA: cannot be performed; not necessary for this measuring type.

PERMASCOPE®, ISOSCOPE® and DUALSCOPE®: adapts the probe to significant changes in physical and geometric properties of the test specimen (permeability, electrical conductivity, geometry, etc.) and compensates for minor probe tip wear.

SIGMA (...) and NICKELSCOPE®: Ability to return the measuring system (probe and instrument) to defined default condition.

CU-SCOPE: Calibration of probe, with new probe tip (probe cartridge), and instrument to basic default condition.

Calibration per Application

A normalization or corrective calibration applies only to the active application. The calibrations (normalization, corrective and master calibration) of other applications remain unaffected. **Exception:** When the application linkage mode is active (menu function 37), the normalization and corrective calibration functions affects all applications which have been set up for the same measuring type and with the same probe as the active application. 📖 See also Chapter 6, page 6-100.
Characteristics of the applications are saved in the respective application memories and for use during the respective measurement. The preset master characteristic in the probe remains unchanged.

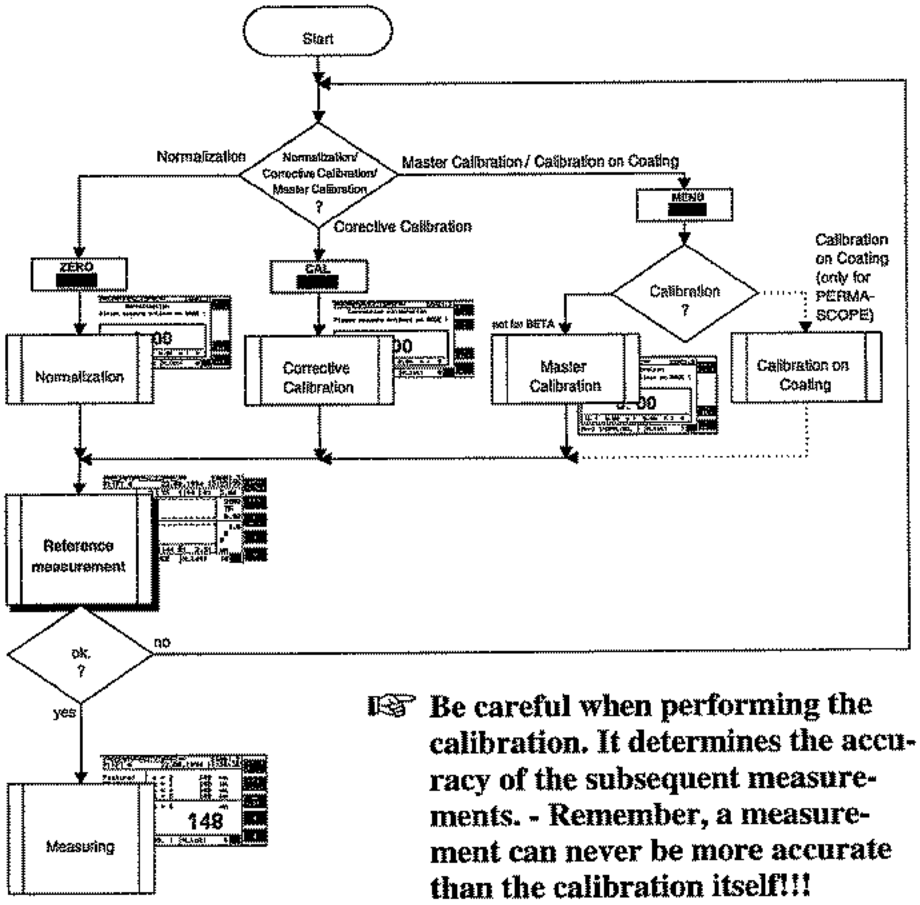
Master Calibration

... erases all corrective calibrations relating to the probe!

The master calibration changes the master characteristic stored in the probe! Thus, the master calibration applies to all applications that have been set up with this particular probe! To prevent erroneous measurements, the **corrective calibrations of all applications relating to this probe will be erased**. Thus, new corrective calibrations may need to be performed for all applications! The normalizations of these applications will not be affected.

☞ There is no master calibration for beta probe .

Figure 7_1 offers an overview of possible calibration functions.



☞ **Be careful when performing the calibration. It determines the accuracy of the subsequent measurements. - Remember, a measurement can never be more accurate than the calibration itself!!!**

Figure 7_1 : Calibration - Overview

7.1 Normalization/Calibration for Coating Thickness Measurements

The main influences producing erroneous measurements during coating thickness measurements are:

- physical properties of the coating and substrate of the specimen (electrical conductivity, permeability, heat treatment)
- the geometric properties of the specimen (shape, thickness of the substrate)
- the measurement area's distance from the edge (edge effect)
- surface roughness

Same Substrate for Calibration Standard and Specimen

A general principle for a coating thickness measurement calibration is that the calibration needs to be performed under conditions that are comparable to the actual measurement on the specimen.
Depending on the measuring type, different calibration standards or calibration foils are required for the normalization/calibration. Calibration standards are reference parts with clean and preferably smooth surfaces. Calibration foils should be free of wrinkles and dents.
Calibration standards and foils are the most important requirements for accurate measurements. They should always be kept in good condition!

☞ **Replace calibration standards and foils with new ones when signs of wear become apparent!** Especially foils less than 50 µm (2 mils) thick are subject to rapid wear. We recommend no more than 100 to 200 measurements before replacing such foils.

☞ For the PERMASCOPE® and the magnetic induction measurement method of DUALSCOPE®, **calibration foils ≤ 30 µm (1.2 mils)** thick must be made of copper-beryllium to avoid indentation errors.

☞ **If "external Start only" is specified for measurement** acquisition in menu function 18, the message "[Extern Start]" will appear in the normalization and calibration menu screens. In this case, measurement acquisition is initiated by an external trigger switch or by pressing the ENTER key of the keypad.

Exception: The GET X0 softkey is always used for acquisition of the air measurement.

Content of the Probe Shipment

☝ The purpose of the **Base material** included with the probe shipment is to check the instrument functions. It can be used to test the repeatability of the instrument. Do **not** use this part for normalizations and calibrations! Use an uncoated part for this purpose.

☞ The **calibration foils** and **saturation standards** that might be included with the probe shipment are used for normalization and calibration of a particular measurement application.
Saturation standards - used for normalization, corrective and master calibration
Calibration foil(s) - used for the corrective calibration
Master foil set - used for the master calibration

7.1.1 Normalization

The normalization adjusts the measurement system (probe and MMS®) to the substrate (uncoated specimen to be measured) and determines the zero point of the probe characteristic.

The MMS® forces the operator to perform a normalization when setting up a new application. The respective normalization parameters are stored in the new application file. A normalization can be performed only for the active application. The calibrations (normalization and corrective calibration) of other applications are not affected. **Exception:** When the Linking Mode is active, the normalization function affects all applications which have been set up for the same measuring type and with the same (equal) probe as the active application. 📖 See also Section '37 Linking of application', page 6-100.

☞ If a **new normalization** (ZERO) is to be performed **for** an already **existing application,** the measurement mode of the desired application must be selected (active).

☞ Previous **measurement data of an application** remain even after a normalization. A new block will always start after normalization.

☞ The normalization of an application is **copied** together with the application.

☞ The continuously calculated mean value is always displayed during the normalization. Continue to perform single measurements until the changes of the mean values are within the **desired accuracy.** With rough surfaces, this can require many single readings.
If there are no specifications the following may be used as a **guideline**:
for n = 10 measurements
smooth surface: s ≤ 0.3 µm (0.12 mils)
rough surface: s = 0.7 to 1 µm (0.28 to 0.40 mils)

☞ Always check the normalization with a **reference measurement.** 📖 See Chapter 6 Section 'Reference Measurement', Page 6-34.

☞ The purpose of the **Base material** included with the probe shipment is to check the instrument functions only. Do **not** use this part for normalization because the material properties of the base material and your product material are always different!

☞ **The production of working calibration standards** see Chapter 8, page 8-1.

☞ Depending on the measuring type, the **saturation standards** included with the probe shipment may also be used for the normalization.

☞ Dual probe: When normalizing an application created with a dual probe and the parameter setting "both methods" in menu function 36, the normalization will be performed only for one test method at first. Additional the normalization also has to be performed for the other test method (zero function, ZERO), so that the coating thickness can be measured correctly with both test methods.

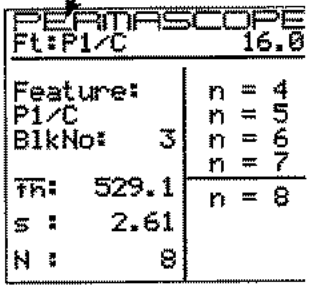
The normalization procedures differ depending on the measuring type and the coating/substrate combination.

Measuring Type	**Coating/Substrate**	**Probe (Exp.)**	**Description Page**
PERMASCOPE®	NC, NF / Fe	EGAB1.3	7-7
ISOSCOPE®	NC / NF	ETA3.3	7-7
DUALSCOPE®	NC / NF and NF / Fe	ED10	7-7
SIGMA (NF/FE)	NF / Fe	ESD1	7-8
SIGMA (DUPLEX)	NC / NF / Fe	ESG2	7-8
SIGMA (CR/NF)	Cr / NF	ESC1	7-26
SIGMA (NI/FE)	Ni / Fe	ESD1	7-10
SIGMA (NF/NC)	NF / NC	ESC1	7-11
CU-SCOPE	Cu / NC	ESL08A	7-11
NICKELSCOPE®	Ni / NF, NC	EN3	7-13

NC: electrically non-conductive and non-ferromagnetic materials.
NF: non-ferromagnetic = non-magnetizable, electrically conductive material
Fe, FE: magnetizable material of steel or iron
Ni, NI: nickel
Cu, CU: copper
Cr, CR: chrome

The different methods of normalization are described on the following pages. The measuring type used for the active application is always displayed in the upper left corner of the MMS® screen (see Figure to the right).

Measuring type of the active Application



```
PERMASCOPE
Ft:P1/C          16.0
Feature:        n = 4
P1/C            n = 5
BlkNo:     3    n = 6
                n = 7
x̄n:   529.1     n = 8
s :    2.61
N :       8
```

PERMASCOPE®
ISOSCOPE®
DUALSCOPE®

7.1.1.1 Normalization for Measuring Types PERMASCOPE®, ISOSCOPE® and DUALSCOPE®

Required:
when setting up a new application and when properties of the specimen change, particularly the geometric properties.

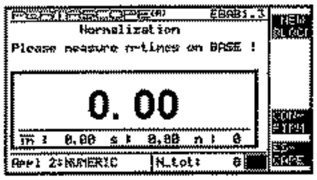
Required Materials:
- Base: uncoated reference part (bare product) corresponding to the material and geometric properties of the finished product.

☝ For measuring type PERMASCOPE® do **not** use the Base material (bare substrate standard) supplied with the shipment - material properties different!!!

Prerequisites:

- For a previously set up application: the application that a new normalization is to be performed for must be active and in measurement mode.
- When setting up a new application: New application is being set up (Menu Function 0).

☞ Please, observe the notes (☞) on page 7-4.



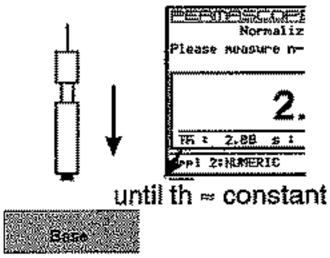
Normalization
Please measure n-times on BASE !
0.00
th : 0.00 s : 0.00 n : 0
Appl 2:NUMERIC N.tot: 0

Procedure

Call Normalization

... for a previously set up application
- Press the **ZERO** key of the keypad.

... when setting up a new application (menu fct. 0)
- Press the softkey **CON-TINUE** .



Measure on Base

- Measure n times on the Base material.
(uncoated reference part.)

Repeat placing the probe on the reference part until the $\overline{th}$-value (mean value) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.

Accept the Normalization Parameters into the Application

- Press the softkey **CON-FIRM** .
End the normalization, save the application together with the normalization parameters.

The measurement mode of the active application appears on the display.

7.1.1.2 Normalization for Measuring Types SIGMA (NF/FE) and SIGMA (DUPLEX)

SIGMA (NF/FE)
SIGMA (DUPLEX)

Required:
when setting up a new application and when properties of the specimen change, particularly the geometric properties.

Required Materials:

- Base: uncoated reference material (bare product) corresponding to the material and geometric properties of the finished product.

☝ Do **not** use the Base material (bare substrate standard) supplied with the shipment - material properties different!!!

- Saturation: Reference part made of the coating material having a thickness at least equal to the depth of penetration of the probe used. The depth of the penetration is mainly a function of the probe type and probe frequency. As long as Copper and Zinc coatings are to be measured, the "Cu" and "Zn" saturation standards supplied by Fischer may be used.

☞ For dual coating thickness measurements (SIGMA (DUPLEX)), saturation means: material of the NF metal coating.

Prerequisites:

- For a previously set up application: The application that a new normalization is to be performed for must be active and in measurement mode.
- When setting up a new application: New application is being set up (Menu Function 0).

☞ Please, observe the notes (☞) on page 7-4.

Procedure

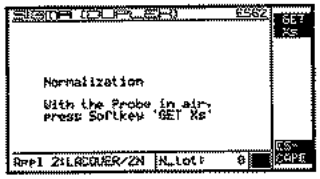
Call Normalization

... for a previously set up application

- Press the **ZERO** key of the keypad.

... when setting up a new application (menu fct. 0)

- Press the softkey **CON-TINUE** .



Normalization

With the Probe in air,
press Softkey 'GET Xs'

Appl 2:LACQUER/ZN N.tot: 0

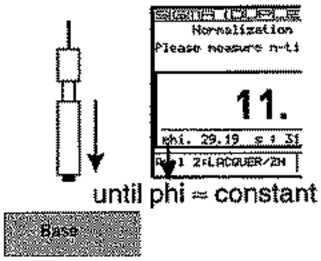
Measure in Air

- Place the probe in air and press the softkey **GET Xs**.

☞ A minimum probe to specimen distance of 5 cm (2 inches) is required.

SIGMA (NF/FE)
SIGMA (DUPLEX)
(continued)

Procedure



Measure on Base

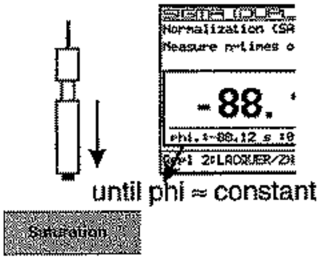
- Measure n times on the Base material.
  (uncoated reference part)

  Repeat placing the probe on the reference part until the phi-value (mean value) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.

Accept the Measurements

- Press the softkey **CON-FIRM**.



Measurement on Saturation

- Measure n times on the saturation standard.
  (reference part with saturation coating thickness)

  Repeat placing the probe on the reference part until the mean phase angle value (phi) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.

Accept the Normalization Parameters into the Application

- Press the softkey **CON-FIRM**.
  End the normalization, save the application together with the normalization parameters.

The measurement mode of the active application appears on the display.

7.1.1.3 Normalization for the Measuring Type SIGMA (NI/FE) and SIGMA (CR/NF)

SIGMA (NI/FE)
SIGMA (CR/NF)

Required:
when setting up a new application and when properties of the specimen change, particularly the geometric properties.

Required Materials:
- Base: uncoated reference material (bare product) corresponding to the material and geometric properties of the finished product.

☝ For measuring type SIGMA (NI/FE) do **not** use the Base material (bare substrate standard) supplied with the shipment - material properties different!!!

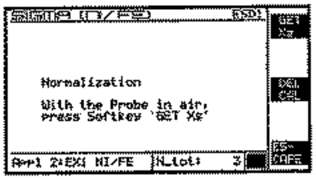
Prerequisites:
- For a previously set up application: The application that a new normalization is to be performed for must be active and in measurement mode.
- When setting up a new application: New application is being set up (Menu Function 0).

☞ Please, observe the notes (☞) on page 7-4.

Procedure

Call Normalization

●



Normalization

With the Probe in air,
press Softkey 'GET Xs'

Appl 2:EX1 NI/FE
N_tot: 3

... for a previously set up application
- Press the ZERO key of the keypad.

... when setting up a new application (fct. 0)
- Press the softkey CON-TINUE.

Measure in Air

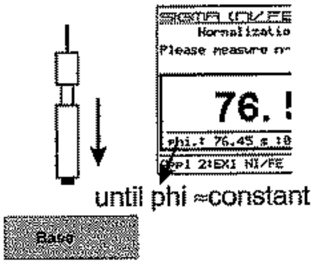
- Place the probe in air and press the softkey GET Xs.

☞ A minimum probe to specimen distance of 5 cm (2 inches) is required.

Measure on Base

- Measure n times on the Base material. (uncoated reference part.)

Repeat placing the probe on the reference part until the mean phase angle value (phi) becomes stable.



☞ In general, about 5 - 10 measurements are sufficient.

SIGMA (NI/FE)
SIGMA (Cr/NF)
(continued)

Procedure

The measurement mode of the active application appears on the display.

Accept the Normalization Parameters into the Application

- Press the softkey CON-FIRM .
  End the normalization, save the application together with the normalization parameters.

SIGMA (NF/NC)
CU-SCOPE

7.1.1.4 Normalization for the Measuring Type SIGMA (NF/NC) and CU-SCOPE

Required:
when setting up a new application and when properties of the specimen change, particularly the geometric properties.

Required Materials:
- Saturation: Reference part made of the coating material having a thickness at least equal to the depth of penetration of the probe used. The depth of the penetration is mainly a function of the probe type and probe frequency. As long as Copper coatings are to be measured, the "Cu" saturation standards supplied by Fischer may be used.

Prerequisites:
- For a previously set up application: The application that a new normalization is to be performed for must be active and in measurement mode.
- When setting up a new application: New application is being set up (Menu Function 0).

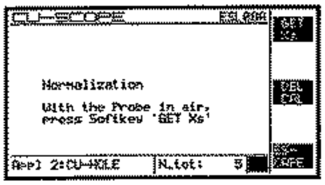
☞ Please, observe the notes (☞) on page 7-4.

Procedure

Call Normalization

... for a previously set up application
- Press the ZERO key of the keypad.

... when setting up a new application (menu fct. 0)
- Press the softkey CON-TINUE .



Normalization

With the Probe in air,
press Softkey 'GET Xs'

Appl 2:CU-HOLE N.tot: 5

SIGMA (NF/NC)
CU-SCOPE
(continued)

Procedure

Measure in Air

- Place the probe in air and press the softkey **GET Xs**.

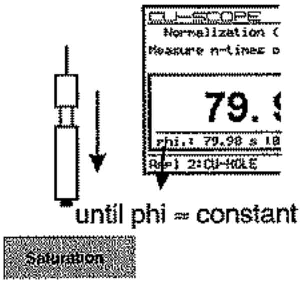
  ☞ A minimum probe to specimen distance of 5 cm (2 inches) is required.

Measure on Saturation

- Measure n times on the saturation standard.

  (reference part with saturation coating thickness)

  Repeat placing the probe on the reference part until the mean phase angle value (phi) becomes stable.



☞ In general, about 5 - 10 measurements are sufficient

☞ When using the **CU-SCOPE measuring type**, hold the probe straight and perpendicular to the board while inserting it into the plated through hole.

Accept the Normalization Parameters into the Application

- Press the softkey **CON-FIRM**.

  End the normalization, save the application together with the normalization parameters.

The measurement mode of the active application appears on the display.

NICKELSCOPE®

7.1.1.5 Normalization for the Measuring Type NICKELSCOPE®

Required:
when setting up a new application and when properties of the specimen change, particularly the geometric properties.

Required Materials:

- Saturation: Reference part made of the coating material having a thickness at least equal to the depth of penetration of the probe used (Nickel). The depth of the penetration is mainly a function of the probe type and probe frequency. The Ni saturation standard included with the shipment can be used.

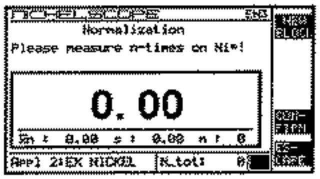
☝ The **saturation standard used for the normalization may not consist of several Ni sheets or foils.** There is always an air gap between two foils/sheets that causes demagnetization and influences the measurement.

Prerequisites:

- For a previously set up application: The application that a new normalization is to be performed for must be active and in measurement mode.
- When setting up a new application: New application is being set up (Menu Function 0).

☞ Please, observe the notes (☞) on page 7-4.

Procedure


NICKELSCOPE
Normalization
Please measure n-times on Ni∞!
0.00
x̄n : 0.00 s : 0.00 n : 0
Appl 2:EX NICKEL
N_tot: 0

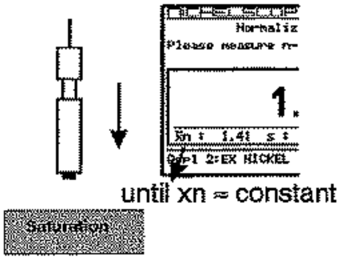
Call Normalization

... for a previously set up application

- Press the **ZERO** key of the keypad.

... when setting up a new application (fct. 0)

- Press the softkey **CON-TINUE** .



Measure on Ni∞ (Saturation)

- Measure n times on Ni∞ (saturation).

Repeat placing the probe on the reference part until the $\overline{Xn}$-value (mean value) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.

The measurement mode of the active application appears on the display.

Accept the Normalization Parameters into the Application

- Press the softkey **CON-FIRM** .
End the normalization, save the application together with the normalization parameters.

7.1.2 Corrective Calibration

A corrective calibration becomes necessary whenever the deviations between nominal and actual, caused by changes in the properties of the specimen, cannot be compensated for by normalization.

Calibration Standards/ Calibration Foils

The corrective calibration more precisely adapts the master characteristic to the specimen (application). It not only makes adjustments to the zero point (Base) and/or ∞ value (saturation), but also to at least one known standards value. Thus, physical property changes of the specimen can be compensated for in addition to geometric changes.
The known standards value is taken from a coated reference part with a known coating thickness. With some measuring types (e.g., PERMASCOPE®) the coating material does not influence the measurement. In such cases, the coating is usually simulated by a calibration foil (for the corrective calibration). This foil is placed on the bare substrate (Base). For measuring types where the coating cannot be simulated by a foil, the reference parts (= calibration standards) must be made with a defined coating thickness. Materials and geometric shapes of the calibration standards must correspond to the ones of the specimen to be measured (e.g., a part taken from the production).

Calibration with 1 or 2 Standards

It is imperative that the corrective calibration is performed with at least one standard. Depending on the application, a second standard can be used to make adjustments. A corrective calibration with two standards (2-point calibration) is advisable with the measuring types SIGMA (...) and NICKELSCOPE® because your specimen will most likely exhibit different material properties (permeability, electrical conductivity, etc.) than those considered during the factory master calibration. Using the 2-point calibration with measuring types PERMASCOPE®, ISOSCOPE® and DUALSCOPE® allows for adaption of the master calibration data to extreme measurement conditions (e. g., highly curved specimen, very small areas, measure near edges, etc.).
A 2-point calibration, therefore, covers a wider adjustment range without the need to perform a new master calibration itself. Other applications using the same probe are not affected by a corrective calibration. A new master calibration affects all applications for the specific probe.

Intervals

The calibration standards and foils used must be within the appropriate normalized countrate (probe signal) interval. The normalize countrate represents the probe signal change from bare substrate material ($Xn = 0$) to coating material saturation thickness ($Xn = 1$).
Calibration standards: $0.02 \leq Xn_{Standard} \leq 0.95$
Calibration foils: $0.1 \leq Xn_{Foil} \leq 0.7$. When using two calibration foils, the difference between the two foil thicknesses must be $\Delta Xn_{Foil} < 0.1$.

See Chapter 6, Section "18 Display Mode/Measurement Trigger", page 6-70 for information on measurements of Xn values (normalized countrate).

☞ The corrective calibration with the calibration foil included with the probe offers the best measurement accuracy for the entire measurement range of the probe. To increase the accuracy in a narrow thickness range, a foil with a thickness covered by this range can be used. However, this usually reduces the accuracy outside this range when compared to the corrective calibration performed with the supplied calibration foil.

The corrective calibration applies only to the active application. The calibrations (normalization and corrective calibration) of other applications will not be affected. **Exception:** When the Linking Mode is active, the corrective calibration function affects all applications which have been set up for the same measuring type and with the same (equal) probe as the active application.
📖 See also Section '37 Linking of application', page 6-100.

☞ If a **corrective calibration** (CAL) is to be performed **for** an already **existing application**, the measurement mode of the desired application must be selected (active).

☞ Previous **measurement data of an application** remain even after a corrective calibration. A new block will always start after a corrective calibration.

☞ The corrective calibration of an application is **copied** together with the application.

☞ The continuously calculated mean value is always displayed during the corrective calibration. Continue to perform single measurements until the changes of the mean values are within the desired accuracy. With rough surfaces, this can require many individual measurements.
If there are no other specifications the following may be used as a **guideline**:
for n = 10 measurements
smooth surface: $s \leq 0.3$ µm (12 mils)
rough surface: $s = 0.7$ to 1 µm (28 to 40 mils)

☞ Always check the corrective calibration with a **reference measurement**.
📖 See Chapter 6, Section "Reference Measurement", Page 6-34.

☞ The purpose of the **Base material** included with the probe shipment is to check the instrument functions only. Do **not** use this part for the corrective calibration because the material properties of the base material and your product material are always different!

☞ The probe shipment includes suitable **saturation standards** and calibration foils for the corrective calibration.

☞ **The production of working calibration standards** see Chapter 8, page 8-1.

☞ Use softkey DEL CAL in the corrective calibration **to delete the corrective calibration** of the active application or of the linked applications. Possible only before or while measuring on the base respectively on the saturation.

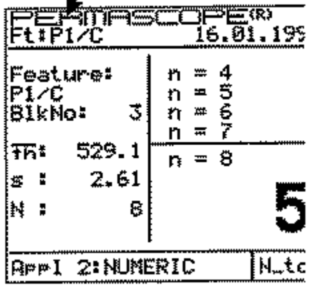
☞ Dual probe: When corrective calibrating an application created with a dual probe and the parameter setting "both methods" in menu function 36, the corrective calibration will be performed only for one test method at first. Additional the corrective calibration also has to be performed for the other test method (zero function, ZERO), so that the coating thickness can be measured correctly with both test methods.

The corrective calibration procedures differ depending on the measuring type and the coating/substrate combination.

Measuring Type	**Coating/Substrate Material**	**Probe (Example)**	**Description 📄 Page**
PERMASCOPE®	NC, NF / Fe	EGAB1.3	7-17
ISOSCOPE®	NC / NF	ETA3.3	7-17
DUALSCOPE®	NC / NF and NF / Fe	ED10	7-17
SIGMA (NF/FE)	NF / Fe	ESD1	7-19
SIGMA (DUPLEX)	NC / NF / Fe	ESG2	7-22
SIGMA (CR/NF)	Cr / NF	ESC1	7-26
SIGMA (NI/FE)	Ni / Fe	ESD1	7-26
SIGMA (NF/NC)	NF / NC	ESC1	7-28
CU-SCOPE	Cu / NC	ESL08A	7-28
NICKELSCOPE®	Ni / NF, NC	EN3	7-31

NC: electrically non-conductive and non-ferromagnetic materials.
NF: non-ferromagnetic = non-magnetizable, electrically conductive material
Fe, FE: magnetizable material of steel or iron
Ni, NI: nickel
Cu, CU: copper
Cr, CR: chrome

The different corrective calibration methods are described on the following pages. The measuring type used for the active application is always displayed in the upper left corner of the MMS® screen (see Figure to the right).



Measuring type of the Active Application

```
PERMASCOPE(R)
Ft:P1/C          16.01.199

Feature:      | n = 4
P1/C          | n = 5
BlkNo:     3  | n = 6
              | n = 7
Th:   529.1   | n = 8
s :    2.61   |
N :       8   |            5

Appl 2:NUMERIC          |N_tc
```

PERMASCOPE®
ISOSCOPE®
DUALSCOPE®

7.1.2.1 Corrective Calibration for Measuring Types PERMASCOPE®, ISOSCOPE® and DUALSCOPE®

Required:
when after a normalization the measurement data of a reference measurement are not acceptable.

Required Materials:

- Base: uncoated reference material (bare product) corresponding to the material and geometric properties of the finished product.

☝ For measuring type PERMASCOPE® do **not** use the Base material (bare substrate standard) supplied with the shipment - material properties different!!!

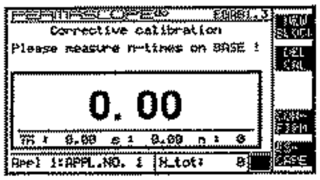
- Calibration foil: Plastic foil of known thickness supplied with the probe, or a plastic foil having a thickness within the coating thickness range to be measured.

Prerequisites:

- The application that a corrective calibration is to be performed for must be active and in measurement mode.

☞ Please, observe the notes (☞) on page 7-15.

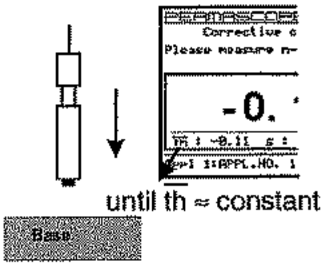
Procedure



Corrective calibration
Please measure n-times on BASE !
0.00
th : 0.00 s : 0.00 n : 0
Appl 1:APPL.NO. 1 N_tot: 0

Call the Corrective Calibration

- Press the **CAL** key of the keypad.



Measure on Base

- Measure n times on the Base material. (Uncoated reference part).
Repeat placing the probe on the reference part until the $\overline{th}$-value (mean value) becomes stable.

☞ In general, about 10 measurements are sufficient.

Accept the Measurements

- Press the softkey **CON-FIRM** to save the correction value for the zero point characteristic and to advance to the next step of the calibration.

PERMASCOPE®
ISOSCOPE®
DUALSCOPE®
(continued)

Procedure

Measure on a Standard 1

Displayed Thickness Differs From Nominal Thickness of Standard

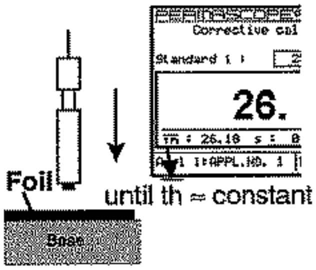
The displayed thickness value can be changed if it does not correspond to the nominal thickness of the standard.

- Press the softkey **ENTER STD**, use the keypad to enter the nominal thickness and confirm the entry with the softkey **CON-FIRM** .

Measure on the Calibration Foil

- Place the calibration foil on the uncoated reference part (Base).
- Measure n times on the foil.
  Repeat placing the probe on the calibration foil until the $\overline{th}$-value (mean value) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.



Accept the Calibration Parameters for Standard

- Press the softkey **CON-FIRM** to save the calibration parameters for the standard and to advance to the next step of the calibration.

☞ After measurement on a second standard: end the corrective calibration, save the application with the corrective calibration parameters, switch to the measurement mode of the active application.

Measure on a Standard 2

If so desired, a second standard can be used to adapt the calibration data to the measurement application. Repeat the procedure described under "Measure on a Standard 1". Otherwise go to the following procedure step.

Accept the Corrective Calibration Parameters into the Application

- Press the softkey **CON-FIRM** .
  End the corrective calibration, save the application together with the corrective calibration parameters.

The measurement mode of the active application appears on the display.

SIGMA (NF/FE)

7.1.2.2 Corrective Calibration for the Measuring Type SIGMA (NF/FE)

Required:
when after a normalization the measurement data of a reference measurement are not acceptable.

Required Materials:

- Base: uncoated reference material (bare product) corresponding to the material and geometric properties of the finished product.

☝ Do **not** use the Base material (bare substrate standard) supplied with the shipment - material properties different!!!

- Saturation: Reference part made of the coating material having a thickness at least equal to the depth of penetration of the probe used. The depth of the penetration is mainly a function of the probe type and probe frequency. As long as Copper or Zinc coatings are to be measured, the "Cu" and "Zn" saturation standards supplied by Fischer may be used.
- Calibration standard (made from actual production part): A reference part with known coating thickness in the range of the coated parts to be measured and which corresponds to the substrate and coating material of the parts to be measured. In many cases this reference part will be identical to the parts to be measured.
  📖 Please refer to Section "The Production of Working Calibration Standards" on page 8-1.

Prerequisites:

- The application that a corrective calibration is to be performed for must be active and in measurement mode.

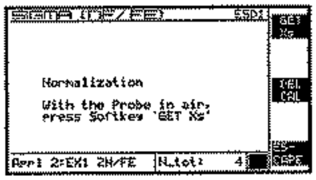
☞ Please, observe the notes (☞) on page 7-15.

Procedure

SIGMA (NF/FE)
(continued)

Call the Corrective Calibration

- Press the **CAL** key of the keypad.



Normalization

With the Probe in air, press Softkey 'GET Xs'

Measure in Air

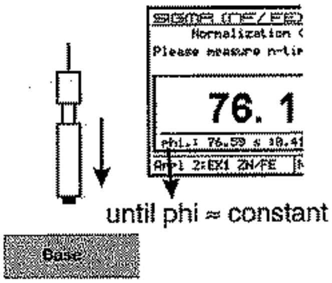
- Place the probe in air and press the softkey **GET Xs** .

☞ A minimum probe to specimen distance of 5 cm (2 inches) is required.

Measure on Base

- Measure n times on the Base material. (Uncoated reference part).
  Repeat placing the probe on the reference part until the phi-value (mean value) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.



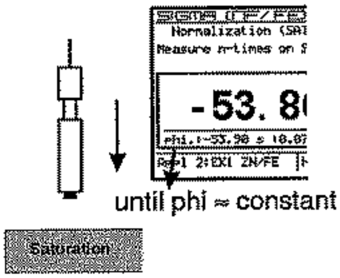
Accept the Measurements

- Press the softkey **CON-FIRM** to save the correction value for the zero point and to advance to the next step of the calibration.

Measure on Saturation

- Measure n times on the saturation standard.
  (Reference part with saturation thickness).
  Repeat placing the probe on the reference part until the mean phase angle value (phi) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.



Accept the Measurements

- Press the softkey **CON-FIRM** to save the correction value for the saturation point and to advance to the next step of the calibration.

Measure on Standard 1

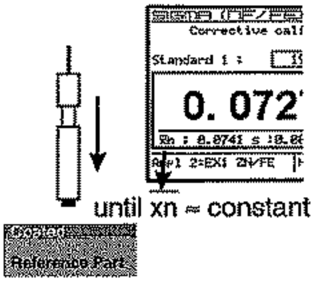
Displayed Thickness Differs From Nominal Thickness of Standard

The displayed thickness value can be changed if it does not correspond to the nominal thickness of the standard.

- Press the softkey **ENTER STD** ,use the keypad to enter the nominal thickness and confirm the entry with the softkey **CON-FIRM**.

Procedure

SIGMA (NF/FE)
(continued)



Measure on the Calibration Standard

- Measure n times on the calibration standard. Repeat placing the probe on the reference part until the $\overline{Xn}$-value (mean value) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.

Accept the Measurement on Standard

- Press the softkey CONFIRM to save the calibration parameters for the standard and to advance to the next step of the calibration.

☞ After measurement on a second standard: end the corrective calibration, save the application with the corrective calibration parameters, switch to the measurement mode of the active application.

Measure on Standard 2

If so desired, a second standard can be used to adapt the calibration data to the measurement application. Repeat the procedure described under "Measure on Standard 1". Otherwise go to the following procedure step.

Accept the Corrective Calibration Parameters into the Application

- Press the softkey CONFIRM .
  End the corrective calibration, save the application together with the corrective calibration parameters.

The measurement mode of the active application appears on the display.

7.1.2.3 Corrective Calibration for the Measuring Type SIGMA (DUPLEX)

SIGMA (DUPLEX)

Required:
when after a normalization the measurement data of a reference measurement are not acceptable.

Required Materials:

- Base: uncoated reference material (bare product) corresponding to the material and geometric properties of the finished product.

☝ Do **not** use the Base material (bare substrate standard) supplied with the shipment - material properties different!!!

- Saturation: Reference part made of the coating material having a thickness at least equal to the depth of penetration of the probe used. The depth of the penetration is mainly a function of the probe type and probe frequency. As long as Zinc coatings are to be measured, The "Zn" saturation standard supplied by Fischer may be used.
- Calibration foil: Plastic foil of known thickness supplied with the probe, or a plastic foil having a thickness within the coating thickness range to be measured.
- Calibration standard (made from actual production part): A reference part with known coating thickness in the range of the coated parts to be measured and which corresponds to the substrate and coating material of the parts to be measured. In many cases this reference part will be identical to the parts to be measured.
  ▤ Please refer to Section "The Production of Working Calibration Standards" on page 8-1.

☞ The duplex probe combines two measuring systems. This probe can be used to measure the thicknesses of two coatings, e.g., paint over zinc on steel substrate; both coating thicknesses will be measured and displayed simultaneously.

Prerequisites:

- The application that a corrective calibration is to be performed for must be active and in measurement mode.

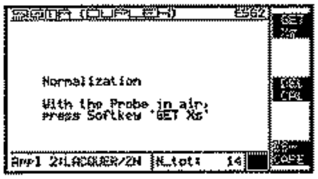
☞ Please, observe the notes (☞) on page 7-15.

SIGMA (DUPLEX)
(continued)

Procedure

Call the Corrective-Calibration

- Press the CAL key of the keypad.



Normalization

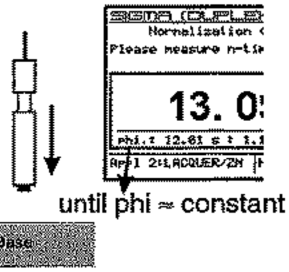
With the Probe in air, press Softkey 'GET Xs'

Appl 2:LACQUER/ZN N_tot: 14

Measure in Air

- Place the probe in air and press the softkey GET Xs.

☞ A minimum probe to specimen distance of 5 cm (2 inches) is required.



Normalization (

Please measure n-tim

phi.: 12.61 s : 1.1

Appl 2:LACQUER/ZN

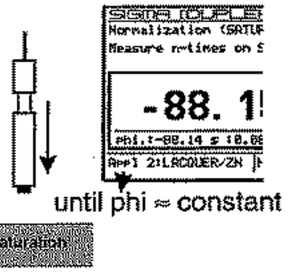
Measure on Base

- Measure n times on the Base material. (Uncoated reference part). Repeat placing the probe on the reference part until the phi-value (mean value) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.

Accept the Measurements

- Press the softkey CON-FIRM to save the correction value for the zero point measurement and to advance to the next step of the calibration.



Normalization (SATUR

Measure n-times on S

phi.:-88.14 s :0.08

Appl 2:LACQUER/ZN

Measure on Saturation

- Measure n times on the saturation standard. (Reference part with saturation coating thickness, no paint or NC coatings). Repeat placing the probe on the reference part until the mean phase angle value (phi) becomes stable.

☞ In general, about 10 measurements are sufficient.

Accept the Measurements

- Press the softkey CON-FIRM to save the correction value for the saturation point and to advance to the next step of the calibration.

Procedure

SIGMA (DUPLEX)
(continued)

Calibration of the duplex probe magnetic induction system (MAGNA)

Measure on the Standard 1
Foil/Base Material

Displayed Thickness Differs From Nominal Thickness of Standard

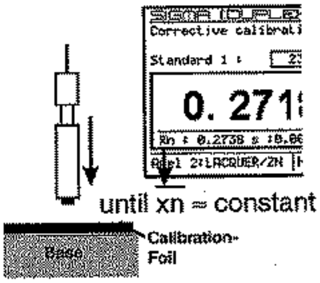
The displayed thickness value can be changed if it does not correspond to the nominal thickness of the standard.

- Press the softkey **ENTER STD**, use the keypad to enter the nominal thickness of the foil and confirm the entry with the softkey **CONFIRM** .

Measure on Calibration Foil

- Place the calibration foil on the uncoated substrate material (Base).
- Measure n times on the calibration foil. Repeat placing the probe on the calibration foil until the $\overline{Xn}$-value (mean value) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient



Accept the Measurement on Standard

- Press the softkey **CONFIRM** to save the calibration parameters for the paint/substrate combination and to advance to the next step of the calibration.

Measure on Standard 2

If so desired, a second standard (foil) can be used to adapt the calibration data to the measurement application. Repeat the procedure described under "Measure on Standard 1 Foil/Base Material". Otherwise go to the following procedure step.

Accept the Measurements

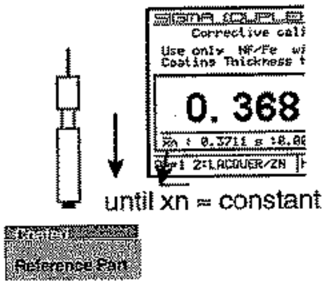
- Press the softkey **CONFIRM** to advance to the next step of the calibration.

Calibration of the duplex probe eddy current system (PHASE)

Measure on Calibration Standard 1
NF/Base Material

- Measure n times on the calibration standard. (NF-coated reference part without paint).
  Repeat placing the probe on the standard until the $\overline{Xn}$-value (mean value) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.



☞ The magnetic induction system of the duplex probe is used to calibrate the eddy current measuring system. Consequently, nominal thicknesses for the calibration standard used are not required in this second part of the corrective calibration.

SIGMA (DUPLEX)
(continued)

Procedure

Accept the Measurement on Standard

- Press the softkey CONFIRM to save the calibration parameters for the NF/substrate combination and to advance to the next step of the calibration.

☞ After measurement on a second standard: end the corrective calibration, save the application with the corrective calibration parameters, switch to the measurement mode of the active application.

Measure on Standard 2

If so desired, a second standard (NF/Base Material) can be used to adapt the calibration data to the measurement application. Repeat the procedure described under "Measure on Calibration Standard 1 NF/Base Material". Otherwise go to the following procedure step.

Accept the Corrective Calibration Parameters into the Application

- Press the softkey CONFIRM .
  End the corrective calibration, save the application together with the corrective calibration parameters.

The measurement mode of the active application appears on the display.

7.1.2.4 Corrective Calibration for the Measuring Type SIGMA (NI/FE) and SIGMA (CR/NF)

SIGMA (NI/FE)
SIGMA (CR/NF)

Required:
when after a normalization measurements on a reference part or standard are not acceptable.

Required Materials:

- Base: uncoated reference material (bare product) corresponding to the material and geometric properties of the finished product.

☝ Do **not** use the Base material (bare substrate standard) supplied with the shipment - material properties different!!!

- Calibration standard (made from actual production part): A reference part with known coating thickness in the range of the coated parts to be measured and which corresponds to the substrate and coating material of the parts to be measured. In many cases this reference part will be identical to the parts to be measured.
  📄 Please refer to Section "The Production of Working Calibration Standards" on page 8-1.

Prerequisites:

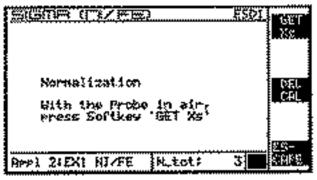
- The application that a corrective calibration is to be performed for must be active and in measurement mode.

☞ Please, observe the notes (☞) on page 7-15.

Procedure

Call Corrective Calibration

- Press the **CAL** key of the keypad.



Normalization

With the Probe in air,
press Softkey 'GET Xs'

Appl 2:EX1 NI/FE
N_tot: 3

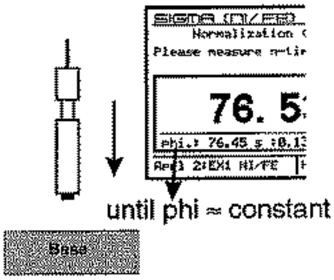
Measure in Air

- Place probe in air and press the softkey **GET Xs**.

Measure on Base

- Measure n times on the Base material. (Uncoated reference part).
  Repeat placing the probe on the reference part until the mean phase angle value (phi) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.



Accept the Measurements

- Press the softkey **CON-FIRM** to save the corrective value for the zero point and to advance to the next step of the calibration.

SIGMA (NI/FE)
SIGMA (CR/NF)
(continued)

Procedure

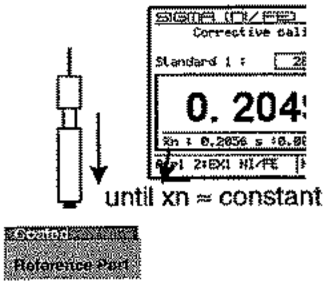
Measure on Standard 1

Displayed Thickness Differs From Nominal Thickness of Standard

The displayed thickness value can be changed if it does not correspond to the nominal thickness of the standard.

- Press the softkey **ENTER STD** , use the keypad to enter the nominal thickness of the standard and confirm the entry with the softkey **CON-FIRM** .

Measure on Calibration Standard



- Measure n times on the calibration standard (Coated reference part). Repeat placing the probe on the reference part until the $\overline{Xn}$-value (mean value) becomes stable.

☞ In general, about 5- 10 measurements are sufficient.

Accept the Measurement on Standard

- Press the softkey **CON-FIRM** to save the calibration parameters for the standard and to advance to the next step of the calibration.

☞ After measurement on a second standard: end the corrective calibration, save the application with the corrective calibration parameters, switch to the measurement mode of the active application.

Measure on Standard 2

If so desired, a second standard can be used to adapt the calibration data to the measurement application. Repeat the procedure described under "Measure on Standard 1". Otherwise go to the following procedure step.

Accept the Corrective Calibration Parameters into the Application

- Press the softkey **CON-FIRM** .
  End the corrective calibration, save the application together with the corrective calibration parameters.

The measurement mode of the active application appears on the display.

7.1.2.5 Corrective Calibration for the Measuring Type SIGMA (NF/NC) and CU-SCOPE

SIGMA (NF/NC)
CU-SCOPE

Required:
when after a normalization measurements on a reference part or standard are not acceptable.

Required Materials:

- Saturation: Reference part made of the coating material having a thickness at least equal to the depth of penetration of the probe used. The depth of the penetration is mainly a function of the probe type and probe frequency. As long as Copper and Zinc coatings are to be measured, the "Cu" and "Zn" saturation standards supplied by Fischer may be used.
- Calibration standard (made from actual production part): A reference part with known coating thickness in the range of the coated parts to be measured and which corresponds to the substrate and coating material of the parts to be measured. In many cases this reference part will be identical to the parts to be measured.
  📖 Please refer to Section "The Production of Working Calibration Standards" on page 8-1.

☞ **Measuring type CU-SCOPE:**

📖 See Chapter 8, Section "Measurement of the Cu Coating Thickness of Plated PC-Board Through Holes", page 8-2 for more detailed explanation regarding production of calibration standards.

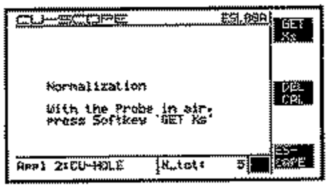
- The corrective calibration uses the coating thickness entered in menu function 20.
- A corrective calibration using the Fischer calibration standard board applies to the specified board thickness ±10 % and a hole diameter range of 0.9 to 1.2 mm (36 to 48 mils).
- **Hold the probe tip straight and perpendicular to the board while inserting it into the plated through holes** - do <u>not</u> place it on the board surface because this results error readings.

Prerequisites:

- The application that a corrective calibration is to be performed for must be active and in measurement mode.

☞ Please, observe the notes (☞) on page 7-15.

Procedure



Normalization

With the Probe in air,
press Softkey 'GET Xs'

Appl 2:CU-HOLE N_tot: 5

Call Corrective Calibration

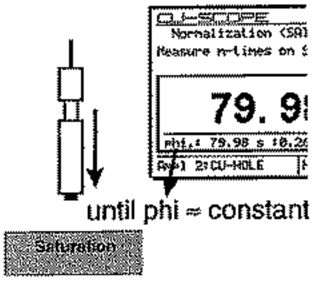
- Press the **CAL** key of the keypad.

Measure in Air

- Place probe in air and press the softkey **GET Xs**.

Procedure

SIGMA (NF/NC)
CU-SCOPE
(continued)



Measure on Saturation

- Measure n times on the saturation standard.
  (Reference part with saturation coating thickness).
  Repeat placing the probe on the reference part until the mean phase angle value (phi) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.

Accept the Measurements

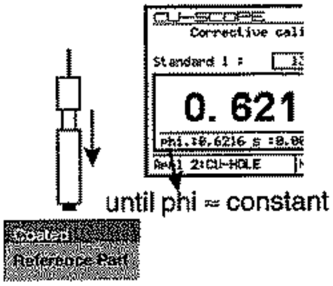
- Press the softkey **CONFIRM** to save the correction value for the saturation point and to advance to the next step of the calibration.

Measure on Standard 1

Displayed Thickness Differs From Nominal Thickness of Standard

The displayed thickness value can be changed if it does not correspond to the nominal thickness of the standard.

- Press the softkey **ENTER STD**, use the keypad to enter the nominal thickness of the standard and confirm the entry with the softkey **CONFIRM** .



Measure on Calibration Standard

- Measure n times on the calibration standard (Coated reference part).
  Repeat placing the probe on the reference part until the mean phase angle value (phi) becomes stable.

☞ In general, about 5- 10 measurements are sufficient.

Accept the Measurement on Standard

- Press the softkey **CONFIRM** to save the calibration parameters for the standard and to advance to the next step of the calibration.

☞ After measurement on a second standard: end the corrective calibration, save the application with the corrective calibration parameters, switch to the measurement mode of the active application.

SIGMA (NF/NC)
CU-SCOPE
(continued)

Procedure

Measure on Standard 2

If so desired, a second standard can be used to adapt the calibration data to the measurement application. Repeat the procedure described under "Measure on Standard 1". Otherwise go to the following procedure step.

Accept the Corrective Calibration Parameters into the Application

- Press the softkey CON-FIRM .
  End the corrective calibration, save the application together with the corrective calibration parameters.

The measurement mode of the active application appears on the display.

NICKELSCOPE®

7.1.2.6 Corrective Calibration for the Measuring Type NICKELSCOPE® (Does not apply to Ni/Fe!)

Required:
when after a normalization measurements on a reference part or standard are not acceptable.

Required Materials:

- Saturation: Reference part made of the coating material having a thickness at least equal to the depth of penetration of the probe used (Nickel). The depth of the penetration is mainly a function of the probe type and probe frequency. The coating material must correspond to the one of the NF coating of the finished product. The Ni saturation standard included with the shipment can be used.

☝ The **saturation standard used for the corrective calibration may not consist of several Ni sheets or foils.** There is always an air gap between two foils/sheets that causes demagnetization and influences the measurement.

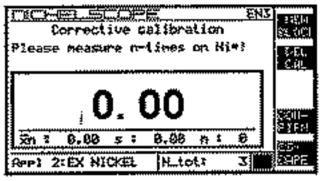
- Calibration standard (made from actual production part): A reference part with known coating thickness in the range of the coated parts to be measured and which corresponds to the substrate and coating material of the parts to be measured. In many cases this reference part will be identical to the parts to be measured.
  📖 Please refer to Section "The Production of Working Calibration Standards" on page 8-1.

Prerequisites:

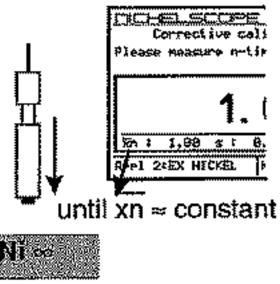
- The application that a corrective calibration is to be performed for must be active and in measurement mode.

☞ Please, observe the notes (☞) on page 7-15.

Procedure


NICKELSCOPE ENS
Corrective calibration
Please measure n-times on Ni∞!
0.00
Xn : 0.00 s : 0.00 n : 0
Appl 2:EX NICKEL | N_tot: 3

Call the Corrective calibration	• Press the CAL key of the keypad.
Measure on Ni∞ (Saturation)	• Measure n times on the saturation standard. (reference part with saturation coating thickness) Repeat placing the probe on the reference part until the $\overline{Xn}$-value (mean value) becomes stable.


NICKELSCOPE
Corrective cali
Please measure n-ti
1.
Xn : 1.00 s : 0.
Appl 2:EX NICKEL

☞ In general, about 5 - 10 measurements are sufficient.

Procedure

NICKELSCOPE®
(continued)

Accept the Measurements

- Press the softkey **CONFIRM** to save the correction value for the saturation point and to advance to the next step of the calibration.

Measure on Standard 1

Displayed Thickness Differs From Nominal Thickness of Standard

The displayed thickness value can be changed if it does not correspond to the nominal thickness of the standard.

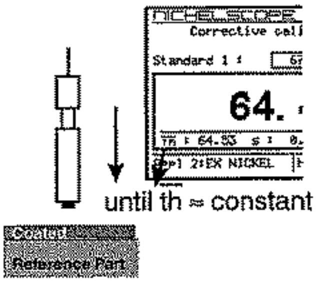
- Press the softkey **ENTER STD**, use the keypad to enter the nominal thickness of the standard and confirm the entry with the softkey **CONFIRM** .

Measure on Calibration Standard

Ni/Substrate

- Measure n times on the calibration standard. (Ni-coated reference part). Repeat placing the probe on the reference part until the $\overline{th}$-value (mean value) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.



Accept the Measurement on Standard

- Press the softkey **CONFIRM** to save the calibration parameters for the standard and to advance to the next step of the calibration.

☞ After measurement on a second standard: end the corrective calibration, save the application with the corrective calibration parameters, switch to the measurement mode of the active application.

Measure on Standard 2

If so desired, a second standard can be used to adapt the calibration data to the measurement application. Repeat the procedure described under "Measure on Standard 1". Otherwise go to the following procedure step.

Accept the Corrective Calibration Parameters into the Application

- Press the softkey **CONFIRM** .
  End the corrective calibration, save the application together with the corrective calibration parameters.

The measurement mode of the active application appears on the display.

7.1.3 Calibration on Coating

For the Measuring Type PERMASCOPE® and DUALSCOPE® NF/Fe

**PERMASCOPE®
DUALSCOPE® NF/Fe**

Required:
The calibration on coating should be performed only if there is no possibility of obtaining an uncoated specimen. Only minor geometric deviations can be corrected with this calibration method.

Required Materials:
- a coated reference part with the same material properties that were present when the master calibration was established!
- a calibration foil ≥ 15 µm (≥ 0.6 mils), see also page 7-15.

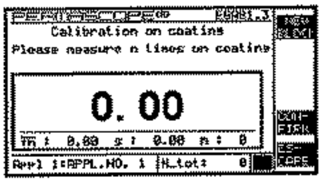
Prerequisites:

- Only for applications that were set up with the PERMASCOPE® or DUALSCOPE® NF/Fe measuring type.
- The calibration must be adapted to the substrate material, that is, material properties such as permeability of the standards used to perform the master calibration may be different to the material properties of the coated specimen to be measured.
- The coating thickness to be measured and used to calibrate must be in the lower 25 % of the probe range.
- The application that a calibration on coating is to be performed for must be active and in measurement mode.

☞ Please, observe the notes on page 7-15.

Description of the menu function 14 see Chapter 6, page 6-64.

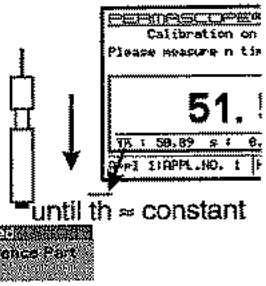
Procedure



```
PERMASCOPE®                          PERM1.3
       Calibration on coating
Please measure n times on coating

               0. 00
 th :  0.00   s :  0.00   n :  0
Appl :APPL.NO. 1 |N_tot:       0
```

Call the Calibration on Coating Function

- Use the keypad to enter function number 14.
- Press the MENU key.



Measure on Coating

- Measure n times on the coated reference part.
Repeat placing the probe on the reference part until the th-value(mean value) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.

PERMASCOPE® DUALSCOPE® NF/Fe
(continued)

Procedure

Accept the Measurements

- Press the softkey CON-FIRM to save the calibration parameters for the standard and to advance to the next step of the calibration.

Measure on Standard

Displayed Thickness Differs From Nominal Thickness of Standard (foil)

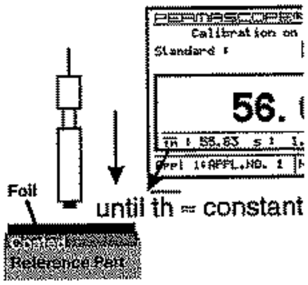
The displayed thickness value can be changed if it does not correspond to the nominal thickness of the standard (foil).

- Press the softkey ENTER STD, use the keypad to enter the nominal thickness of the standard and confirm the entry with the softkey CON-FIRM .

Measure on Calibration Foil

- Place the calibration foil on the coated reference part.
- Measure n times on the calibration foil. Repeat placing the probe on the calibration foil until the $\bar{th}$-value (mean value) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.



Accept the Calibration Parameters into the Application

- Press the softkey CON-FIRM.
End the calibration on coating, save the application together with the new calibration parameters.

The measurement mode of the active application appears on the display.

PERMASCOPE®
ISOSCOPE®
DUALSCOPE®
SIGMA
NICKELSCOPE®
CU-SCOPE

7.1.4 Master Calibration

Calibration of probe and instrument to a new default condition.

BETA: cannot be performed; is not necessary for this measuring type.

PERMASCOPE®, ISOSCOPE® and DUALSCOPE®: adapts the probe to significant changes in physical and geometric properties of the specimen (permeability, electrical conductivity, geometry, etc.) and compensates for minor probe tip wear.

SIGMA (...) and NICKELSCOPE®: Ability to return the measuring system (probe and instrument) to a defined new default condition.

CU-SCOPE: Calibration of probe, with new probe tip (probe cartridge) or probe holder, and instrument to a new default condition.

The master calibration data are stored in the probe. This data is used for converting the probe output signal into coating thickness.

⚠ **A new master calibration updates the master calibration data in the probe!**

The master calibration applies, therefore, to all applications that are set up with this probe (referenced by its serial number).

☝ **To avoid measurement error, the corrective calibrations for all applications that have been set up with the probe will be deleted when a new master calibration is performed. Please perform new corrective calibrations for the respective applications, if needed.**

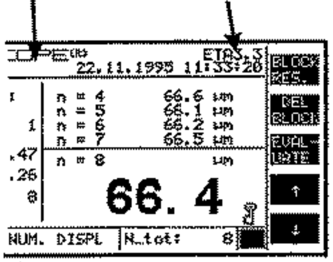
During a master calibration, a new master calibration curve is established based on the following data: zero point (base), ∞ value (saturation), and four calibration standards values. Calibration standards used for the master calibration should be of the highest quality and the calibration must be performed meticulously!

☝ **The master calibration should be performed with FISCHER calibration standards.**

☞ A probe-specific master calibration standard set can be obtained from Fischer.

Measuring type of the active application

Name of probe used and connected for the active application



```
OPE(R)              ETA3.3
   22.11.1995 11:33:20
I  n = 4      66.6 um
   n = 5      66.1 um
1  n = 6      66.2 um
   n = 7      66.5 um
.47 n = 8          um
.26
8        66. 4
NUM. DISPL  N_tot:     8
```

Prerequisite:

- The master calibration will be performed for the probe displayed in the active application.

Calling the Master Calibration

- Call menu function 15: Press 1 5 and MENU.

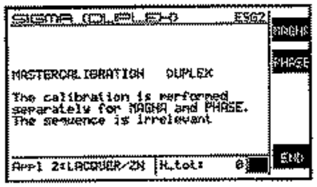
Depending on the measuring type used, in general the procedure for the master calibration will be the same as that for the corrective calibration. However, contrary to the corrective calibration, four standards (calibration foils, calibration standards) are needed for the master calibration. The order in which the standards are used is not important. The respective nominal value needs to be entered for each standard. During the master calibration, use the CON-FIRM softkey to switch to the menu of the next standard.

☞ The master calibration cannot be performed if the correct probe for the active application is not connected.

☞ A master calibration establishes the correlation between the probe signal and the displayed measured value. 📖 See also Chapter 6, page 6-70 Section "XN:". **The standards XN measurements have to be within certain intervals** to obtain an accurate master calibration. Press the softkey INTER-VALS to display these intervals.

☞ **If the Xn measurements do not fall within the ranges** the menu page cannot be closed (CON-FIRM). Try the measurement again with the proper standard.

Important Notes



MASTERCALIBRATION DUPLEX

The calibration is performed separately for MAGNA and PHASE. The sequence is irrelevant

Appl 2:LACQUER/ZN | H.tot: 0

Duplex Probe ESG2: For the duplex probe, both measurement systems (MAGNA and PHASE) are calibrated separately using four standards each. Four calibration foils (master foil set) are used for the MAGNA (magnetic induction) measurement system and four calibration standards for the measurement system PHASE (eddy current system).

☞ A respective master calibration standard set can be obtained from Fischer.

ESL08A Probe:

⚠ **The master calibration data stored in the probe connector is replacement cartridge specific. Thus, a master calibration needs to be performed when replacing the probe tip (cartridge) or the probe holder in this probe.**

☞ Five standards are required for the **CU-SCOPE measuring type with probe ESL08A.** The board thickness is assumed to be 1.5 mm (59 mils). Entering the board thickness in menu function 20 does not affect the master calibration.

☞ A calibration standard board can be obtained from Fischer under order number.

SIGMASCOPE®

7.2 Normalization/Calibration for Electrical Conductivity Measurements

The main parameters influencing electrical conductivity measurements are:

- The geometric shape of the specimen (curvature, diameter of the measurement area, thickness of the specimen)
- The distance between the measurement probe and the specimen (lift-off effect)
- The temperature of the specimen

For more details about the influencing parameters listed above see Chapter 9, starting with page 9-1.

Reference Parts Required for the Normalization/Calibration

Electrical conductivity probes are shipped with the master calibration data including the data for saturation using 100 % IACS (copper) or 58 MS/m conductivity. The electrical conductivity data are referenced to 20 °C (68 °F).
Electrical conductivity standards are required to calibrate the measuring system:

Normalization:
Air value only, an electrical conductivity standard is not required.

Corrective Calibration:
Uses electrical conductivity standards below 100 % IACS or 58 MS/m conductivity. The electrical conductivity value of the standard for the correction should be selected such that it falls in the center of the conductivity range to be measured. In general, the electrical conductivity data of the standards will be referenced to 20 °C (68 °F).

Master Calibration:
A minimum of five electrical conductivity standards (maximum of eight) must be used. The electrical conductivity of one standard must be between 97 % and 103 % IACS (copper) and that of a second standard ≤ 10 % IACS. The other standards can be selected freely.

Electrical conductivity standards are uncoated reference parts with clean smooth surfaces. They are the most important prerequisites for accurate measurements and should always be kept in good condition!

☞ **Replace Worn Calibration Standards in a Timely Manner!**

☞ Additional **certified electrical conductivity standards** can be obtained from Fischer.

Temperature Influence

The temperature influences the conductivity of the standards. Thus, the standards should be at a temperature of 20 °C (68 °F) to avoid errors due to differing temperature coefficients.

SIGMASCOPE®

7.2.1 Normalization

Normalization is used to adjust the measuring system to the zero point (0 % IACS or MS/m). Normalization is temperature-independent. It is assumed that ambient and specimen temperatures are the same.

The MMS® forces the user to perform a normalization when a new application is set up. The respective normalization parameters will be saved in the new Application file. A normalization can be performed only for the active application. Calibrations (normalization, corrective calibration) of other applications will not be affected. **Exception:** When the application linkage mode is active, the normalization function affects all applications which have been set up for the same measuring type and with the same probe as the active application.
🗐 See also Chapter 6, page 6-100.

☞ To perform a **new normalization (ZERO) for** an **existing application**, the measurement mode of the desired application must be selected (active).

☞ Previous **measurement data of the application** will remain even after the normalization. A new block will always start after a normalization.

☞ The normalization of an application is **copied** together with the application.

☞ It is always recommended to check the normalization with a **reference measurement**. 🗐 See Chapter 6 Section Reference Measurement, page 6-34.

Required: When setting up a new application.

Required Materials: Electrical conductivity standards are not required.

☞ If the **measurement area is curved**, then the Cu-standard must be of the same geometric shape as the specimen. 🗐 See also Chapter 9, Section "Geometry of the Specimen", page 9-5.

Prerequisites:

- For a previously set up application: the application that a new normalization is to be performed for must be active and in measurement mode.
- When setting up a new application: New application is being set up (MenuFunction0).

Procedure

Call Normalization

... for a previously set up application

- Press the ZERO key.

... when setting up a new application (Menu 0)

- Press softkey CON-TINUE .

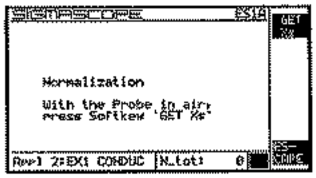
Measure in Air

- Place the probe in air and press the softkey GET Xs .

☞ A minimum probe to specimen distance of 5 cm (2 inches) is required.

Normalization is exited automatically after the air value is measured and the application is stored with the normalization parameters.

SIGMASCOPE®



Normalization

With the Probe in air, press Softkey 'GET Xs'

Appl 2:EXt CONDUC N_tot: 0

The measurement mode of the active application appears on the display.

SIGMASCOPE®

7.2.2 Corrective Calibration

A corrective calibration becomes necessary whenever a normalization is not sufficient to restore full measurement accuracy. Loss of measurement accuracy may be attributable to changes in measurement conditions such as temperature changes, test specimen geometry changes, etc.

The corrective calibration, more precisely than the normalization, adapts the master characteristic stored in the probe to the geometry of the specimen. It not only makes adjustments to the electrical conductivity values of 0 MS/m (0 % IACS) but also to one interim value. Up to four standards can be used to perform the corrective calibration.

The electrical conductivity of the standards should cover the expected measurement range.

The corrective calibration applies to the active application. The calibrations (normalization and corrective calibration) of other applications will not be affected. Exception: When the application linkage mode is active, the normalization function affects all applications which have been set up for the same measuring type and with the same (equal) probe as the active application.
📖 See also Chapter 6, page 6-100.
If the application was set up with temperature compensation, the current temperature will be taken into consideration during the corrective calibration, otherwise it will not be taken into consideration.

Corrective calibration without temperature compensation page 7-41
Corrective calibration with temperature compensation page 7-43

☞ If a **corrective calibration** (CAL)is to be performed for an existing application, the measurement mode of the desired application must be selected (active).

☞ **Previous measurement data of an application** remain even after a corrective calibration is performed. A new block will always start after a corrective calibration.

☞ The corrective calibration of an application is copied together with the application.

☞ Always check the corrective calibration with a **reference measurement.**
📖 See Chapter 6 Section Reference Measurement, Page 6-34.

SIGMASCOPE®

Corrective Calibration Without Temperature Compensation

For the corrective calibration without temperature compensation, the influence of the temperature is taken into consideration by having the standard and the specimen at the same temperature. If measurements are made, for instance, at 23 °C (73.4 °F) instead of at 20 °C (68 °F) and if the value noted on the standard (referenced to 20 °C (68 °F)) is entered during the corrective calibration, then the result on the specimen measured at 23 °C (73.4 °F) will also be referenced to 20 °C (68 °F). However, the result will not be totally accurate depending on the differences of the respective temperature coefficients (of standard and specimen).

☞ For accurate measurements, place the electrical conductivity standards for 2 to 3 minutes near of the specimen so that they can reach the temperature of the specimen .

☞ If the **measurement area is curved**, then the Cu-standard must be of the same geometric shape as the specimen or a correction factor must be applied. 📖 See also Chapter 9, Section "Geometry of the Specimen", page 9-5.

Required:

when after a normalization the measurement data of a reference measurement are not acceptable and the corrective calibration and the measurement are performed at the same material temperature.

Required Materials:

- Standard: with an electrical conductivity value that is within the expected measurement range.

Prerequisites:

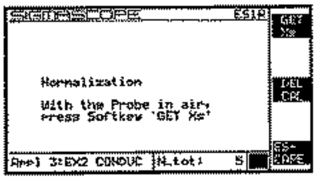
- The application (without temperature compensation) that a corrective calibration is to be performed for must be active and in measurement mode.

☞ Please, observe the descriptions and the notes (☞) on page 7-40.

Procedure

Call Corrective Calibration

- Press the CAL key of the keypad.



Normalization

With the Probe in air, press Softkey 'GET Xs'

Appl 3:EX2 CONDUC N,tot: 5

Measure in Air

- Place the probe in air and press the softkey GET Xs .

☞ A minimum probe to specimen distance of 5 cm (2 inches) is required.

Procedure

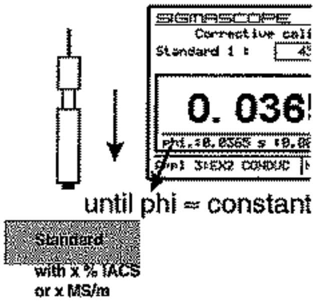
SIGMASCOPE®

Measure on Standard 1

Displayed Value Differs From Nominal Conductivity of Standard

The displayed conductivity can be changed if it does not correspond to the nominal conductivity of the standard.

- Press the softkey **ENTER STD**, use the keypad to enter the nominal conductivity and confirm the entry with the softkey **CON-FIRM** .



Measure on Standard 1

- Measure n times on the standard. Repeat placing the probe on the standard until the mean phase angle value (phi) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.

Accept the Measurement on Standard

- Press the softkey **CON-FIRM** to save the calibration parameters for the standard and to advance to the next step of the calibration.

☞ After measurement on a fourth standard: end the corrective calibration, save the application with the corrective calibration parameters, switch to the measurement mode of the active application.

Measure on Standard 2 (3, 4)

If so desired, a second and/or third and/or fourth standard can be used to adapt the calibration to the measurement application. Repeat the procedure described under "Measure on Standard 1" for each further standard. Otherwise go to the following procedure step.

The measurement mode of the active application appears on the display.

Accept the Corrective Calibration Parameters into the Application

- Press the softkey **CON-FIRM** .
  End the corrective calibration; save the application together with the corrective calibration parameters.

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Corrective Calibration With Temperature Compensation

Required:
when after a normalization the measurement data of a reference measurement are not acceptable and the corrective calibration and the measurement are performed at different material temperatures.

Required Materials:
- Standard: with an electrical conductivity value that is within the expected measurement range.

☞ If the **measurement area is curved,** then the saturation standard must be of the same geometric shape as the specimen or a correction factor must be applied. See also Chapter 9, Section "Geometry of the Specimen", page 9-5.

Prerequisites:

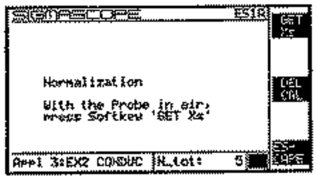
- The application (with temperature compensation) that a corrective calibration is to be performed for must be active and in measurement mode.
- The temperature and the temperature coefficient (α) of the standards must be known. The required data for the Cu standard included with the probe shipment can be obtained from the test certificate (included with shipment).

☞ Please, observe the descriptions and the notes (☞) on page 7-40.

Procedure

Call Corrective Calibration

- Press the CAL key of the keypad.



Normalization

With the Probe in air, press Softkey 'GET Xs'

Appl 3:EX2 CONDUC N_tot: 5

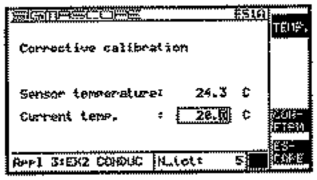
Measure in Air

- Place the probe in air and press the softkey GET Xs .

☞ A minimum probe to specimen distance of 5 cm (2 inches) is required.

Enter the Current Temperature of the Standard

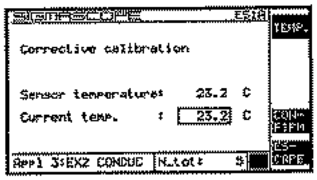
- Use the numeric keys of the keypad to enter the temperature.
Or
Connect a surface temperature probe to the MMS® (MULTIFUNCTION socket) and measure the surface temperature of the specimen ("Sensor temperature"). Confirm the "Sensor temperature" reading as the specimen temperature ("Current temp.") with the softkey TEMP.
- Confirm the temperature entry with the CON-FIRM key.



Corrective calibration

Sensor temperature: 24.3 C
Current temp. : 20.0 C

Appl 3:EX2 CONDUC N_tot: 5



Corrective calibration

Sensor temperature: 23.2 C
Current temp. : 23.2 C

Appl 3:EX2 CONDUC N_tot: 5

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Procedure

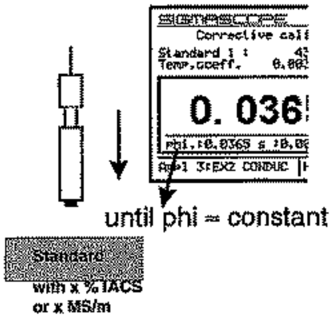
Measure on Standard 1

Displayed Value Differs From Nominal Conductivity of Standard

The displayed conductivity or temperature coefficient can be changed if they do not correspond to the nominal conductivity or temperature coefficient (α) of the standard.

- Press the softkey **ENTER STD** , use the keypad to enter the nominal values and confirm the entries with the softkey **CON-FIRM** .

Measure on Standard 1



- Measure n times on the standard. Repeat placing the probe on the standard until the phi-value (mean value) becomes stable.

☞ In general about 5 - 10 measurements are sufficient.

Accept the Measurement on Standard

- Press the softkey **CON-FIRM** to save the calibration parameters for the standard and to advance to the next step of the calibration.

☞ Use the softkey **CON-FIRM** to switch to the menu of the next standard or to end the corrective calibration, save the application with the corrective calibration parameters, switch to the measurement mode of the active application.

Measure on Standard 2 (3, 4)

If so desired, a second and/or third and/or fourth standard can be used to adapt the calibration to the measurement application. Repeat the procedure described under " Measure on Standard 1" for each further standard. Otherwise go to the following procedure step.

Accept the Corrective Calibration Parameters into the Application

- Press the softkey **CON-FIRM** .
End the corrective calibration; save the application together with the corrective calibration parameters.

The measurement mode of the active application appears on the display.

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7.2.3 Master Calibration

The master calibration data are stored in each probe. The data form the basis for converting the probe output signal into the electrical conductivity.

A new master calibration updates the master calibration data in the probe.

The master calibration applies, therefore, to all applications that are set up with this probe (referenced by its serial number).

To avoid measurement errors, the corrective calibrations in all applications that have been set up with the probe will be deleted when a new master calibration is performed. Please perform new corrective calibrations for the respective applications, if needed.

During a master calibration, a new master calibration curve established based on the following data: Zero point, ∞ value (saturation), and at least three (maximum of six) intermediate values. Calibration Standards used for the master calibration should be of high quality and the calibration must be performed meticulously.

Prerequisites:

- The master calibration will be performed for the probe displayed in the active application.
- A minimum of five electrical conductivity standards (maximum of eight) must be used. The electrical conductivity of one standard must be between 97 % and 103 % IACS (copper) and that of a second standard ≤ 10 % IACS. The other standards can be selected freely.
- Conductivity (σ) and temperature coefficient (α) must be known for the standards used. This data must be entered in menu function 14 "Standards Master Calibration" before performing the master calibration.
  see Chapter 6, Page 6-65for a description of the menu functions.

Enter Conductivity and Temperature Coefficient in menu function 14

Calling the Master Calibration

- Call menu function 15: Press 1, 5, and MENU.

Depending on the measuring type used, in general, the procedure for the master calibration will be the same as that for the corrective calibration. However, contrary to the corrective calibration, a minimum of five standards (calibration standards) are needed for the master calibration. The order in which the standards are used is not important. The respective conductivity (σ) and temperature coefficient (α) values

SIGMASCOPE®

must be entered in menu function 14. During the master calibration, use the CONFIRM softkey to switch to the menu of the next standard.

☞ The master calibration cannot be performed if the correct probe for the active application is not connected.

☞ The softkey INTERVALS have no function for the measuring type SIGMASCOPE®.

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7.3 Normalization/Calibration for Ferrite Content Measurements

The main parameters influencing ferrite content measurements are:

- The curvature of the specimen
- The material thickness
- The influence of the ferritic steel substrate for clad surfaces
- The wear of the probe tip

For more details about the influencing parameters listed above see Chapter 10, starting with page 10-1 .

Reference Parts Required for the Normalization/Calibration

Only in rare cases does the user have his own special standards for the ferrite content measurement. Thus, a Fischer Ferrite Calibration Standard Set is required.
This calibration standard set can be used to

- test instrument functions, or
- compensate for minor probe tip wear (Normalization) or significant probe tip wear (Corrective Calibration).

The calibration standards are uncoated reference parts with clean smooth surfaces. They are the most important prerequisites for accurate measurements and should always be kept in good condition!

☞ **Replace Worn Calibration Standards in a Timely Manner!**

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7.3.1 Normalization

Normalization is used to adjust the measuring system to the saturation value, that is to 100 % ferrite content (or 140 FN).

The MMS® forces the user to perform a normalization when a new application is set up. The respective normalization parameters will be saved in the new Application file. A Normalization can be performed only for the active application. Calibrations (normalization and corrective calibration) of other applications will not be affected. **Exception:** When the Linking Mode is active, the normalization function affects all applications which have been set up for the same measuring type and with the same (equal) probe as the active application.
📄 See also Chapter 6, page 6-100.

☞ To perform a **new normalization** (ZERO) **for** an **existing application**, the measurement mode of the desired application must be selected (active).

☞ Previous **measurement data of an application** will remain even after the application. A new block will always start after a normalization.

☞ The normalization of an application is **copied** together with the application.

☞ It is always recommended to check the normalization with a **reference measurement.** 📄 See Chapter 6 Section "Reference Measurement", page 6-34.

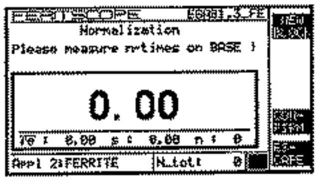
Required:
When setting up a new application and for minor probe tip wear.

☞ **Probe tip wear** is apparent when the nominal values of the calibration standard set can no longer be measured properly.

Required Materials:
- Base: Reference part with 100 % ferrite content (or 140 FN).

Prerequisites:

- The application that a measurement is to be performed for must be active and in measurement mode.
- New application is in the process of being set up (Menu Function 0).



Normalization
Please measure n-times on BASE !
0.00
x̄ : 0.00 s : 0.00 n : 0
Appl 2:FERRITE N_tot: 0

Call Normalization

Procedure

... for an application set up previously
... when setting up a new application (Menu Function 0)

- Press the ZERO key of the keyboard.
- Press softkey CON-TINUE .

Procedure

Measure on Base

- Measure n times on the base material.
  (Reference part with 100 % Fe / 140 FN)
  Repeat placing the probe on the standard until the $\overline{fe}$-value (mean value) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient.

Accept the Normalization Parameters into the Application

- Press the softkey **CON-FIRM** .
  End the normalization, save the application together with the normalization parameters.

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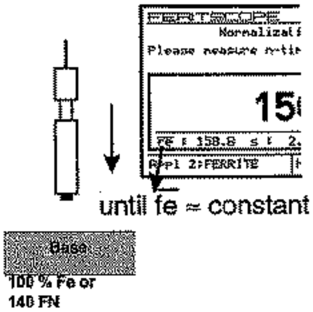

The measurement mode of the active application appears on the display.

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7.3.2 Corrective Calibration

A corrective calibration becomes necessary whenever the deviations between nominal and actual measurement, caused by changes in the measuring system, cannot be compensated for by normalization. Specimen with a very small and/or curved measurement area may also require a corrective calibration.

📖 See also Chapter 10, "Ferrite Content Measurement".

The corrective calibration precisely adapts the probe master characteristic to the geometry of the specimen. It not only makes adjustments to the 100-%Fe value (Base) but also up to three interim values. A corrective calibration for specimens with very small and/or curved measurement areas must be performed with customer specific calibration standards (same geometry as the specimen and with a known δ ferrite content).

The δ ferrite content of the corrective calibration standards should be in the expected measurement range. We recommend to always perform the corrective calibration with 3 standards.

Respective calibration standard sets can be ordered from Fischer.

☞ The corrective calibration for specimens with extremely small and/or curved measuring surfaces must be performed with customer-specific standards (same geometry as specimen and known ferrite content δ).

The corrective calibration applies to the active application. The calibrations (normalization and corrective calibration) of other applications will not be affected. Exception: When the application linkage mode is active, the corrective calibration function affects all applications which have been set up for the same measuring type and with the same (equal) probe as the active application.
📖 See also Chapter 6, page 6-100.

☞ If a **corrective calibration** (CAL) is to be performed for an existing application, the measurement mode of the desired application must be selected (active).

☞ **Previous measurement data of an existing application** remain even after a corrective application. A new block will always start after a corrective calibration.

☞ The corrective calibration of an application is **copied** together with the application.

☞ Always check the corrective calibration with a **reference measurement**.
📖 See Chapter 6 Section "Reference Measurement", Page 6-34.

☝ If the **results** of a reference measurement with all 3 calibration standards are **not within the expected range** even after a corrective calibration, probe tip wear is the most likely cause. We recommend to send the probe to Fischer for tip replacement.

Required:
when after a normalization the measurement data of the calibration standard set are not acceptable or when the geometry of the measurement surface is very irregular.

Required Materials:
- Fischer calibration standard set, containing one base and 3 standards.

☞ Calibration standard sets can be ordered from Fischer.

Prerequisites:

- The application that a corrective calibration is to be performed for must be active and in measurement mode.

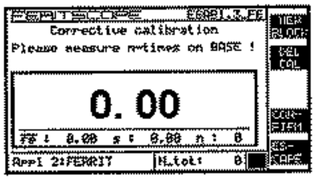
Procedure

Call the Corrective Calibration

- Press the CAL key of the keypad.

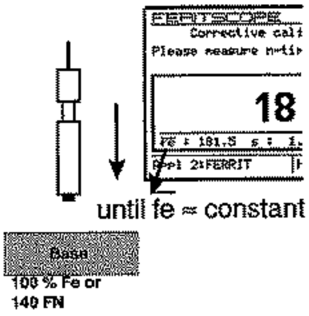
Measure on Base

- Measure n times on the Base material. (Reference part with 100 % Fe or 140 FN) Repeat placing the probe on the reference part until the fe-value (mean value) fluctuations are within specified limits.



Corrective calibration
Please measure n-times on BASE !
0. 00
fe : 0.00 s : 0.00 n : 0
Appl 2:FERRIT
N.tot: 0

☞ In general, about 5- 10 measurements should be sufficient.



Accept the Measurement Data

- Press the softkey CON-FIRM to save the saturation value and to advance to the next step of the calibration.

Measure on Standard 1

Displayed Value Differs From the Nominal Ferrite Content of the Standard

The displayed ferrite content can be changed if it does not correspond to the nominal ferrite content of the standard.

- Press the softkey ENTER STD, use the keypad to enter the nominal ferrite content value and confirm the entry with the softkey CON-FIRM .

Procedure

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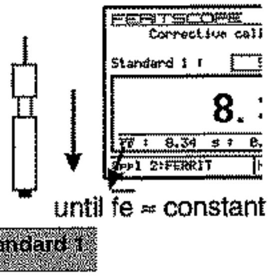


with x % Fe or x FN

Measure on Standard 1

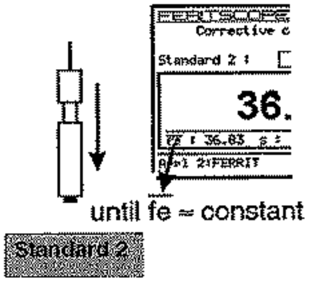
- Measure n times on the standard. Repeat placing the probe on the standard until the fe-value (mean value) becomes stable.

☞ In general, about 5 - 10 measurements are sufficient

Accept the Measurement Data

- Press the softkey CON-FIRM to save the calibration parameters for the standard and to advance to the next step of the calibration.

☞ After measurement on a third standard: end the corrective calibration, save the application with the corrective calibration parameters, switch to the measurement mode of the active application.



with x % Fe or x FN

Measure on Standard 2 (3)

If so desired, a second and/or third standard can be used to adapt the calibration data to the measurement application. Repeat the procedure described under "Measure on Standard 1" for each further standard. Otherwise go to the following procedure step.

Accept the Corrective Calibration Parameters into Application

- Press the softkey CON-FIRM . End the corrective calibration; save the application together with the corrective calibration parameters.

The measurement mode of the active application appears on the display.

7.3.3 Master Calibration

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Master Calibration

A Master Calibration for the measuring system is performed at Fischer using a suitable master calibration standard set. A master characteristic establishing the correlation between the measuring signal and % FE or FN is generated by this calibration. The master characteristic is stored in the probe. The master calibration is performed for both units of measurement. The respective master characteristic is automatically selected upon selection of the unit of measurement.

⚠ **A new master calibration updates the master calibration data in the probe.**

The master calibration applies, therefore, to all applications that are set up with this probe (referenced by its serial number).

☝ **To avoid measurement errors, the corrective calibrations in all applications that have been set up with the probe will be deleted when a new master calibration is performed. Please perform new corrective calibrations for the respective applications, if needed.**

During a master calibration, a new master calibration curve established based on the following data: ∞value (saturation) and at least four intermediate values. Calibration Standards used for the master calibration should be of high quality and the calibration must be performed meticulously.

⚠ **Only qualified personnel authorized by Fischer are permitted to perform a master calibration.**

Severe
Probe tip Wear
?

Before you consider to perform a master calibration, check whether the probe tips are worn too much. If reference measurements with all three calibration standards result in fluctuations of the measurements by more than ±10 % around the nominal value of the calibration standard, significant probe tip wear is the most likely cause. For the calibration standard 2% Fe (2 FN), this value is ± 0,5 % around the nominal value.

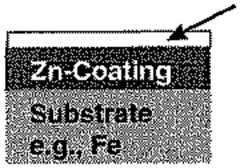
We recommend to send the probe to Fischer for probe tip replacement.

7.4 Lift-Off Compensation

SIGMA
SIGMASCOPE®

All probes for the SIGMA (...) and SIGMASCOPE® measuring types are lift-off compensated at the factory. This means that up to a certain thickness a top coating made of a non-conductive material such as paint does not influence the coating thickness or electrical conductivity measurement.

Example:



Paint coating - does not influence the measurement of the zinc coating.

☞ The thickness of the max. permissible top coating depends on the probe type used.

Checking the Lift-Off Compensation

The lift-off compensation can be checked at any time; it does not depend on a valid calibration.
The coating/substrate combination or the conductivity of the material to be measured is not significant for this check, as long as the test method is suitable for the combination or material.

- Measure n times on the specimen.
  Coating thickness measurement: coated specimen without paint coating, the coating thickness need not be known.
  Electrical conductivity Measurement: reference part without paint or NC coating.
- Place a plastic foil with a thickness of 200 to 300 µm (8 to 12 mils) on the specimen.
- Measure n times on the plastic foil.
  The results of both measurements should be identical. A lift-off compensation must be performed if the difference of the two measurement results is > 1 %. To perform the lift-off compensation send the instrument together with the probe to your nearest Fischer service facility.

☞ The accuracy of the actual measurement is not important when checking the lift-off compensation. If the lift-off compensation is OK, the deviation of the results between the measurement with and without the plastic foil will be in a range of 0.5 to 1 % of the measurement.

7.5 Normalization/Calibration for Coating Thickness Measurements With Beta Isotopes

BETA

The most important parameters affecting coating thickness measurements with the beta backscatter method are:

- the material composition of the coating to be measured.
- the platen aperture/isotope combination.
- substrate and base material of the standard are different from the test specimen.
- the densities of the coating material and of the standard coating material are different.

A calibration for coating thickness measurements must be performed under conditions that are comparable to the conditions that are present during measurements on the specimen.

☞ **In general, a calibration should be performed for every platen aperture/isotope/coating/substrate combination!**

Two types of calibration are used for the beta backscatter test method:

Normalization

- Compensation for platen aperture and isotope influences (isotope decay, temperature effects).
- If the substrate has a similar composition (alloy) but not the same atomic number as the base material of the calibration standard, a normalization must be performed after the calibration.

Normalization:
1x daily
for application
in use

Calibration

- When setting up an application.
- When the countrate of the isotope has decreased too much (depending on the isotope after about 3 to 6 months; see also the Table in Appendix A of the "Instructions for Handling the Platen Aperture, Isotope, and Calibration Standards").

Calibration:
3 to 6 months
depending on isotope

To assure a specified measurement accuracy, see Chapter 6, 'Normalization to Specified F_{norm}', Page 6-76 or Calibration to Specified Fcal', Page 6-80.

BETA

Perform Calibration/Normalization only after proper warm-up of the GM tube!

The calibration procedure should be performed only after proper warm-up of the counter tube. This will prevent detector warm-up drift from influencing the measurement. Probe and measuring table should, therefore, not be exposed to large temperature fluctuations! The warm-up period of the counter tube takes a minimum of 5 minutes. Connect the probe/measuring table to the MMS® and power up the MMS®.

Calibration Standards Calibration Standard Set

Various calibration standards are used for the normalization/calibration. The calibration standards are reference parts with clean smooth surfaces.
Standards are the most important prerequisites for accurate measurements and should always be kept in good condition!

A calibration standard set consists of a base and saturation standard (pure substrate and coating material) and one to four standards with defined coating thicknesses.

Calibration standards must be selected such that the base and saturation standards conform to the substrate and coating materials of the specimen. A normalization after the calibration can correct differences of similar base materials. The base to substrate material difference should not be more than one atomic number.
Example: Gold measurement on Bronze. A calibration can be performed with a Nickel calibration standard set (Ni-Base), since the atomic numbers of Nickel and Bronze differ only by one. A subsequent normalization on Bronze (uncoated specimen) corrects the "error" of the calibration on Ni (Base).

See also Example 1 BETA in Chapter 4, page 4-53 .

☞ The MMS® automatically forces a calibration when setting up a new application.

☞ A normalization or calibration can only be performed for **one application** at a time. Calibrations (normalization, calibration) of other applications are not affected.

☞ To perform a normalization/calibration (ZERO / CAL) for an existing application, the measurement mode of the desired application must be selected (active).

☞ Previous measurements of an application remain. A new block is always started after a normalization/calibration.

☞ **The production of working calibration standards** see Chapter 8, page 8-1.

7.5.1 Normalization

BETA

- Shape and size of aperture,
- changes in the compositions of the coating and substrate materials,
- intermediate coating, and
- curvature of the specimen,

these influencing factors can usually be corrected through normalization.

The countrates of the base and the saturation materials are determined with the normalization. This adjusts the measuring system to the substrate and coating materials. The normalization can correct the calibration curve (stored in the Application) without loss of measurement accuracy as long as the countrates (Base -> Xo, Saturation -> Xs) of the normalization do not differ by more than ± 10 % from those stored in the Application.

Normalization when ?

Required Normalizations:

- **daily for each application used.**
- **for changes in the coating/substrate material combination.**
- **for changes in the JEWELRING® aperture platens.**

☞ Previous measurements of the application remain. A new block always begins after a normalization.

Required Materials:

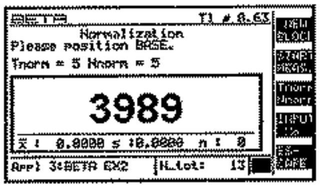
- Substrate material (Base) of same shape and thickness and with the same material properties as the uncoated specimen.
- Saturation: Reference part made of the coating material having a thickness at least equal to the depth of penetration of the probe used. The depth of the penetration is mainly a function of the probe type (for the isotope).

☞ Calibration standard set, can be used if Base and/or Saturation standard are the same as substrate and coating material of the specimen.

Prerequisites:

- The application to be used for measurement must be active and in measurement mode.

BETA



```
BETA                          T1 ≠ 0.63
          Normalization
Please position BASE.
Tnorm = 5 Nnorm = 5
               3989
x̄ :  0.0000 s :0.0000  n :  0
Appl 3:BETA EX2      N_tot:      13
```

Procedure

Call Normalization

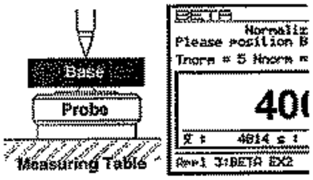
- Press the **ZERO** key on the keypad.

Enter N_{norm} and T_{norm}

- Press the softkey **Tnorm Nnorm** .
  Depending on the required measurement precision (F_{norm}) the values for measurement time (T_{norm}) and the number of measurements per calibration measurement series (N_{norm}) must be changed here. Use **ENTER** to switch between the entry windows.

Accept the Entry

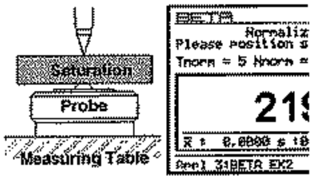
- Press the softkey **CON-FIRM** .
  The calibration will now be performed with the new settings.



Measure on Base

- Measure N_{norm} times on Base.
  (Uncoated standard).
  Reposition the standard for each measurement. Start the measurement either with the GO key at the measuring table or with the **START MEAS.** softkey.

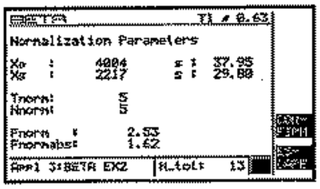
☞ After the measurement on Base, the MMS® switches automatically to the Saturation measurement menu page.



Measure on Saturation

- Measure N_{norm} times on Saturation.
  (Saturation coating material, saturation standard).
  Reposition the standard for each measurement. Start the measurement either with the GO key at the measuring table or with the **START MEAS.** softkey.

☞ The normalization parameters will appear on the display automatically after the last measurement.



```
BETA                          T1 ≠ 0.63
Normalization Parameters
Xo   :       4004        s :   37.95
Xs   :       2217        s :   29.80
Tnorm:          5
Nnorm:          5
Fnorm   :        2.53
Fnormabs:        1.62
Appl 3:BETA EX2      N_tot:      13
```

Accept the Normalization Parameters

- Press the softkey **CON-FIRM** to save the countrates.

7.5.2 Calibration

BETA

- Substrate material (atomic number)
- Coating material (atomic number)
- Isotope type

During a calibration, a calibration curve is established as a function of the above three factors. Calibration measurements are not only made on Base (Xo) and Saturation (Xs) but, depending on the measurement application, for at least one thickness standard with known coating thickness.
In general, a calibration is performed with 3 to 4 standards. That is, in addition to Base and Saturation, three to four coated standards (with known and different coating thicknesses) are used.

A calibration is always required when the spectrum of the back-scattered beta particles changes significantly:

Calibration when?

every 3 Months for Cd-109

every 6 Months for
PM-147
Tl-204
Bi-210
Sr-90
Ru-106

Calibration required

- **every 3 months for Cd isotopes.**
- **every 6 months for other Fischer isotopes (Tl-204, Pm-147,...).**
- **when the probe geometry changes.**
- **when changes occur in the GM tube.**

☞ A calibration must always be performed when setting up a new Application.

☞ Previous measurements of an application remain. A new block is always started after a calibration.

Required Materials:
- Substrate material (Base) of same shape and thickness and with the same material properties as the uncoated specimen.
- Saturation: Reference part made of the coating material having a thickness at least equal to the depth of penetration of the probe used. The depth of the penetration is mainly a function of the probe type (of the isotope).
- Calibration standard: A reference part with known coating thickness in the range of the coated parts to be measured and which correspond to the substrate and coating material of the parts to be measured. In many cases this reference part will be a Fischer calibration standard. Otherwise this reference part will be identical to the parts to be measured. 📖 The production of working calibration standards see Chapter 8, page 8-1.

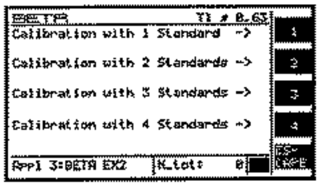
☞ Calibration standard set suited for your measurement application can be ordered from Fischer.

BETA

Prerequisite:

- The application to be used for measurement must be active and in measurement mode.
- New application is being set up (Menu Function 0).

Procedure



```
BETA                          Ti ≠ 0.63
Calibration with 1 Standard   ->     1
Calibration with 2 Standards  ->     2
Calibration with 3 Standards  ->     3
Calibration with 4 Standards  ->     4
                                     ES-
Appl 3:BETA EX2    N_tot:      0     CAPE
```

Call Calibration

... for a previously set up application

- Press the **CAL** key of the keypad.

... when setting up a new application (menu function 0)

- Press the softkey **CONTINUE**.

Select the Number of Standards Used

- Press the softkeys **1** to **4**, depending on the number of coated standards in the calibration standard set.

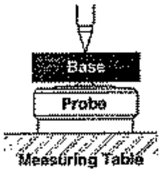
☞ The selection is automatically followed by a switch to the calibration routine.

Enter N_{cal} and T_{cal}

- Press the softkey **Tnorm Nnorm**. Depending on the required measurement precision (F_{cal}), the values for measurement time (T_{cal}) and the number of measurements per calibration measurement series (N_{cal}) must be changed here. Use **ENTER** to switch between the entry windows.

Accept the Entry

- Press the softkey **CONFIRM**. The calibration will now be performed with the new settings.



```
BETA
  Calibration wit
Please position B
Tcal  = 5 Ncal  =
               40
X :     3998 s :
Appl 3:BETA EX2
```

Measure on Base

- Measure N_{cal} times on Base. (Uncoated reference part). Reposition the reference part for each measurement. Start the measurement with the GO key at the measuring table or with the **START MEAS.** softkey.

☞ After the measurement on Base, the MMS® switches automatically to the saturation measurement menu page.

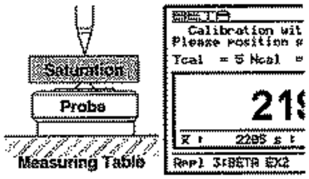
Procedure

BETA

Measure on Saturation

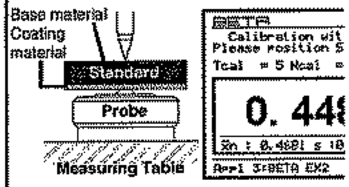
- Measure N_{cal} times on Saturation. (Saturation coating material, saturation standard). Reposition the standard for each measurement. Start the measurement either with the GO key at the measuring table or with the START MEAS. softkey.

☞ After the saturation measurement, the MMS® switches automatically to the measurement menu of the first standard.



Measure on Standard 1

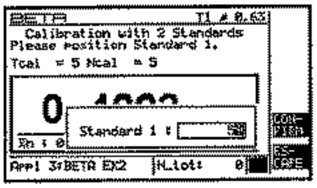
- Position the first (coated) standard. (The order of the standards is freely selectable.) Reposition the standard for each measurement. Start the measurement either with the GO key at the measuring table or with the START MEAS. softkey.



Enter the Coating Thickness Value for the Standard 1

- After the last measurement you are automatically prompted to enter the standard value. The respective entry window will open.
- Use the softkey CONFIRM to accept the entry.

☞ After confirmation of the entry, the MMS® switches automatically to the measurement menu of the next standard.

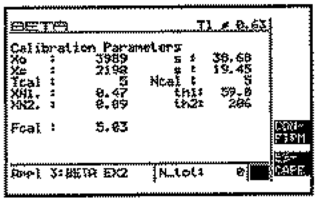


```
BETA                             T1 # 0.63
  Calibration with 2 Standards
Please position Standard 1.
Tcal  = 5 Ncal  = 5
   0.4000
        Standard 1 :
Xn : 0
Appl 3:BETA EX2      N_tot:        0
```

Measure on Next Standard

- Position the next (coated) standard. (The order of the standards is freely selectable.) Repeat the procedure as described under "Measure on Standard 1" until a measurement series has been performed for every standard.

☞ The calibration parameters will appear automatically on the display after the last standard value has been entered.



```
BETA                             T1 # 0.63
Calibration Parameters
Xo    :        3989      s :   30.68
Xe    :        2198      s :   19.45
Tcal  :           5   Ncal :       5
XN1.  :        0.47    th1:    59.0
XN2.  :        0.09    th2:     206

Fcal  :        5.03

Appl 3:BETA EX2      N_tot:        0
```

Accept the Calibration Parameters

- Press the softkey CONFIRM to save the parameters

☞ The calibration parameters can be used to check the quality of the calibration. Switch to the measurement mode of the application.

BETA

8 Coating Thickness Measurement

This chapter contains information necessary for coating thickness measurements according to certain measuring types.

8.1 The Production of Working Calibration Standards

PERMASCOPE®
ISOSCOPE®
DUALSCOPE®
SIGMA
CU-SCOPE
NICKELSCOPE®
BETA

The probe output signal is mainly function of the coating thickness, probe type, the conductivity and permeability of the coating- and substrate materials. To take these material properties into account frequently a calibration standard must be produced from actual test specimen (production part). For suitability as a calibration standard the selected part must have a uniform coating thickness. The determine the coating thickness uniformity the part should measured in several places over the significant area. This can be done with the MMS® unit, the accuracy of the measurement is not important for this purpose because the coating is checked for uniformity only. The standard deviation of the measurements made can be an indicator of coating uniformity. If the part is found to be suitable, the next step is the determination of the true coating thickness by another suitable test method. This can be the Coulometric method, the XRF method or even the microscope cross section method, as long as a sufficiently large area of the part remains to serve as a calibration standard. After coating thickness determination mark the part to indicate the measurement location and coating thickness.

CU-SCOPE

8.2 Measurement of the Cu Coating Thickness of Plated Pc-Board Through Holes

With probe ESL08A, the FISCHERSCOPE® MMS® can be used to measure the thickness of the copper plating in pc-board through holes fast, accurately, and non-destructively.

📑 See also Chapter 5, Section 'Settings for Copper Plating Thickness Measurements in Pc-Board Plated Through Holes', Page 5-10.

📑 See also Chapter 6, Section 'Description of the Menu Functions', Pages 6-75, 6-79, 6-82.

8.2.1 Influencing Factors

Geometric Influences

- **Board Thickness**
  This influence is adjusted for by entering the board thickness in Menu Function 20. The entered thickness must be within the tolerance of ± 10 %.

☞ See Chapter 6, Section 'Description of the Menu Functions', Page 6-75.

- **Hole Diameter**
  This influence is taken into account through the corrective calibration (master calibration). Corrective calibrations performed with the Fischer calibration board cover a hole diameter range of 0.9 to 1.2 mm (36 to 48 mils).

☞ It may be necessary to increase the probe sensitivity for hole diameters >1,2 mm. 📑 See Chapter 6, Section 'Description of the Menu Functions', Page 6-82.

- **Laminate Thickness or Thickness of Intermediate Layers for Multilayers PCB**[15]
  The influence of this factor is negligible.

Sn or SnPb Coating

Due to the significantly lower electrical conductivity when compared to copper, an approx. 10 µm (400 µin) thick SnPb coating in the through hole results in a 10% higher Cu thickness at a copper thickness of approx. 25 µm (1 mil). This influence decreases with an increase in the Cu thickness.

CU-SCOPE

Electrical Conductivity

The electrical conductivity of chemically deposited or electroplated copper depends to a large degree on the bath composition. The Fischer calibration board corresponds to the copper quality of modern electroplating baths and should permit an accurate calibration for most general practical applications.

However, a corrective calibration with one's own standards should be performed if particular bath conditions indicate that a significantly different electrical conductivity should be expected.

See the following Section 'Notes on Producing Your Own PTH Calibration Standards'.

Temperature

The higher the copper temperature, the lower the electrical conductivity. Assuming that the electroplated copper has the same temperature coefficient as pure copper, a change in the electrical conductivity of 4% must be taken into account for each 10 °C difference in temperature from the corrective calibration. This is done in Menu Function 21.

See Chapter 6, Section 'Description of the Menu Functions', Page 6-79.

Example:
Temperature of the calibration board: +20 °C
Temperature of the pc-board to be measured: + 30 °C
Unless a correction factor (96%) is entered in Menu Function 21, the copper thickness displayed is 4% lower than the actual value.

CU-SCOPE

8.2.2 Notes on Producing Your Own PTH Calibration Standards

In most cases, you will only need to produce your own PTH standards for larger hole diameters (larger than 1.2 mm or 0.05").
To make a standard from an actual production pc-board requires that you measure several holes of the desired diameter with the FISCHERSCOPE® MMS®. The aim is to find a number of holes which produce nearly identical copper thickness readings. Ideally, the hole copper thickness measurements should be within 1 - 1.5 %. After you have selected about 2 - 3 suitable holes, determine the copper thickness in all but one of the holes by an appropriate method, such as microscopic cross section. Average the copper thickness of the sectioned holes. Assign the average copper thickness to the hole which you did not cross section and use this hole as a standard.
In general, one corrective calibration with one standard (Cu thickness and hole diameter in the same range as the ones to be measured) should be sufficient for the ESL08A probe.

☞ The MMS® with an ESL08A probe can be used for pre-measurements to select suitable through-holes if the system has had a corrective calibration with a "FISCHER" calibration board and if a correction factor has been entered (menu function 21) to account for the hole size.

8.2.3 Defect Recognition

Transverse cracks running across the entire circumference or large-area defects in the copper coating of the plated through hole are recognized and displayed as insufficient coating thicknesses.
The probe sensitivity is distributed around the circumference. Short transverse cracks can be recognized through fluctuations of the displayed coating thickness when turning the probe.

BETA

8.3 Coating Thickness Measurement With the Beta Backscatter Method

Not every coating/substrate combination can be measured with the beta backscatter method. In general, a difference in the atomic number of the two materials of 20 % is required. Table 8_1 shows measurement applications suitable for the beta backscatter method.

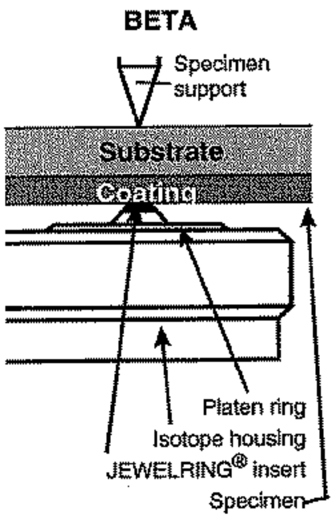
Substrate	Coating																
	Ag	Al	Au	Cd	Ce	Cr	Cu	In	Ni	Non-metal	Pb	Pd	Pt	Rh	Solder	Sn	Zn
Iron and Steel	●	●	●	●				●		●	●	●	●	●	●	●	
Copper, Brass, Bronze	●	●	●	●				●		●	●	●	●	●	●	●	
Zn and Zn Alloys	●	●	●	●	●			●		●	●	●	●	●	●	●	
Al and Al Alloys	●		●	●	●	●	●	●	●		●	●	●	●	●	●	●
Mg and Mg Alloys	●		●	●	●	●	●	●	●		●	●	●	●	●	●	●
Ni	●	●	●	●	●			●		●	●	●	●	●	●	●	
Ag		●	●		●		●	●	●	●	●		●		●		●
Ni and Kovar	●	●	●	●				●		●	●	●	●	●	●	●	
Non-metals	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●
Ti	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●

Table 8_1: Coatings that can be measured on various substrates using the beta backscatter method

To measure correctly with the beta backscatter method, suitable apertures, isotopes and calibration standards need to be selected.

The following sections describe the selection of the optimal isotopes and platen apertures.

8.3.1 Platen Aperture

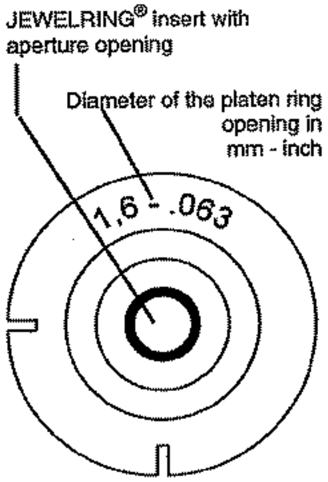


Measurement Structure

Each isotope is covered by an aperture platen. The platen limits the diameter of the electron beam impacting the specimen, and it serves as a support when placing the specimen on the probe (or vice versa). To achieve high abrasion resistance, all FISCHER platen apertures feature a JEWELRING® insert with a slotted or round opening to define the measurement area.

Aperture Size

For the desired measurement application, the platen opening should be selected as large as possible to achieve the highest possible measurement precision, but small enough to suit the test area.
The shape of the platen opening (circular or slotted) depends on the shape of the area to be measured.



Top view of a circular aperture (enlarged)

The following basic formula applies to circular openings:

$$\varnothing_{Ap} = 0.7 \bullet \varnothing_{DM}$$

$\varnothing_{Ap}$: Diameter of the platen opening
$\varnothing_{DM}$: Diameter of the area to be measured

The following basic formula applies to slotted openings:

$$W_{Ap} = \sqrt{0.2 \bullet \varnothing_{DS}}$$

W_{Ap}: Width of the platen opening in mm
$\varnothing_{DS}$: Diameter of the specimen in mm

Note: This formula for use in mm units only !

The diameter, or width, of the platen ring opening is engraved on the platen ring. Example: 1,6 - .063 describes a platen ring diameter of 1.6 mm or 0.063 inches. Slotted apertures have a rectangle engraved in front of the numbers (▯).

Selected aperture size suitable for application ?

Positioning Error

Different countrates will result, depending on the degree of coverage, if the platen opening is only partially covered by the specimen. With repeated positioning of the specimen, different areas will be exposed to the beta rays resulting in different countrates. This countrate scatter distorts the measurement and is expressed by an increased standard deviation (s).
Conclusion: Repeated positioning of the specimen on the platen should not result in a increased spread of the measurement result than is inherent to the test method.

BETA

The degree of countrate scatter can be checked with a simple test measurement:

- Set up an application
  Menu function 0, 📄 see also Chapter 6, Page 6-45
  $T_{meas} = 5$ sec, Set measurement time, if necessary

- Perform 10 measurements (N = 10) on the uncoated specimen. Reposition the specimen after every measurement.

The platen used is suitable for the measurement application if the following equation is satisfied:

$$\frac{\textit{standard deviation s}}{\textit{theoretical standard deviation } \sigma} \langle 1.55$$

In measurement mode, both standard deviations (s and σ) can be viewed on the display.
σ = theoretical predicted standard deviation
s = measured standard deviation

The platen opening is too large if the result is > 1.55. Select a platen with a smaller aperture and repeat the test.

BETA

The coating thickness to be measured/expected is known

8.3.2 Isotope

Similar to probes there are suitable isotope types for the various measurement applications. Table 8_2 shows guidelines for the most suitable (logarithmic) measurement ranges for different coating/substrate combinations depending on the isotope used.

Table 8_2: Suitable measurement ranges of various beta isotopes for some coating/substrate combinations

Isotope		PM-147			TL-204			Sr-90		
Coating	Substrate	Range[1] mils	Range[1] µm	Th_{max}[2] mils µm	Range[1] mils	Range[1] µm	Th_{max}[2] mils µm	Range[1] mils	Range[1] µm	Th_{max}[2] mils µm
Ag, Rh, Pd	Au Cu, Ni, Fe Al	0.05 ... 0.16 0.05 ... 0.16 0.04 ... 0.17	1.2 ... 4.0 1.2 ... 4.0 1.0 ... 4.2	0.6 15	0.24 ... 1.0 0.22 ... 0.8 0.20 ... 0.8	6.0 ... 25 5.5 ... 22 5.0 ... 22	2.4 60	0.6 ... 3.0 0.6 ... 2.8 0.4 ... 2.4	15 ... 75 15 ... 70 10 ... 60	7.6 190
Al	Cu, Ni, Fe	0.18 ... 0.8	4.5 ... 20	3.6 90	1 ... 4	25 ... 100	14.4 360	3.6 ... 16	90 ... 400	50.8 1270
Au	Ag, Mo Cu, Ni, Fe Al	0.02 ... 0.09 0.02 ... 0.08 0.02 ... 0.07	0.6 ... 2.3 0.5 ... 2.0 0.5 ... 1.8	0.28 7	0.1 ... 0.48 0.1 ... 0.4 0.1 ... 0.4	2.5 ... 12 2.5 ... 10 2.5 ... 10	1.2 30	0.20 ... 1.4 0.22 ... 1.4 0.2 ... 1.0	5.0 ... 35 5.5 ... 35 5.0 ... 25	4 100
Cd	Cu, Ni, Fe	0.06 ... 0.2	1.5 ... 5.0	0.72 18	0.28 ... 1.2	7 ... 30	3.2 80	0.6 ... 2.8	15 ... 70	10.8 270
Cr	Al	0.08 ... 0.32	2.0 ... 8.0	1.2 30	0.32 ... 1.2	8 ... 30	4.6 115	0.8 ... 4.8	20 ... 120	16.4 410
Cu, Ni	Ag, Mo Al	0.06 ... 0.20 0.07 ... 0.22	1.5 ... 5.0 1.7 ... 5.5	0.8 20	0.36 ... 1.2 0.32 ... 1.2	9 ... 30 8 ... 30	3.4 85	0.8 ... 4 0.6 ... 4	20 ... 100 15 ... 100	12 300
Sn	Pb Cu, Ni, Fe Al	0.07 ... 0.22 0.07 ... 0.22 0.06 ... 0.20	1.8 ... 5.5 1.8 ... 5.5 1.5 ... 5.0	0.88 22	0.3 0... 1.4 0.30 ... 1.4 0.28 ... 1.2	7.5 ... 35 7.5 ... 35 7.0 ... 30	3.6 90	0.6 ... 4.0 0.6 ... 4.0 0.4 ... 2.8	15 ... 100 15 ... 100 10 ... 70	12.4 310
Sn60Pb40	Cu, Ni, Fe	0.04 ... 0.18	1.1 ... 4.5	0.48 12	0.2 ... 1.1	5 ... 28	2 50	0.4 ... 3.2	10 ... 80	10 250
Zn	Al	0.06 ... 0.24	1.5 ... 6.0	1 26	0.2 ... 1.2	4 ... 30	4.4 110	0.4 ... 4.8	11 ... 120	14.8 370
Paint	Ni, Cu Al	0.4 ... 1.6	11 ... 40	8 200	2 ... 8	50 ... 200	30 750	7.2 ... 24	180 ... 800	100 2500

1) Measurement Range (logarithmic range) according to DIN EN ISO 3543, BS 5411, ASTM B 567

2) Th_{max} almost corresponds to saturation thickness.

BETA

Coating/Substrate material combination is not listed in Table 8_2

The isotopes listed in Table 8_2 are suitable for elements with neighboring atomic numbers. Select an isotope for a coating/substrate combination not listed in Table 8_2 by looking up similar atomic numbers of the coating and substrate materials. Table 8_3 lists elements in alphabetical order together with their atomic number while Table 8_4 lists the elements sequentially by atomic number.

Example: Which isotope is suitable for the measurement of a Palladium coating with a thickness of 2 µm (80 µin) thickness on Silicon? The atomic numbers of palladium and silicon can be taken from Table 8_3; elements with neighboring atomic numbers are shown in Table 8_4.
Palladium (Pd) has an atomic number of 46, the neighboring element, Silver (Ag), with an atomic number of 47, is listed in Table 8_2 as a coating material.
Silicon (Si) has an atomic number of 14, the neighboring element, Aluminum (Al), with an atomic number of 13, is listed in Table 8_2 as a substrate.
Table 8_2 shows Pm-147 as suitable isotope for the coating/substrate combination Ag/Al and a coating thickness of 2 µm (80 µin). Based on the similar atomic numbers, the isotope Pm-147 is also suited for the coating/substrate combination Pd/Si with a coating thickness of 2 µm (80 µin).

Table 8_3 List of Elements with their atomic numbers, sorted by name

Element name	Symbol	Atomic number
Aluminum	Al	13
Antimony	Sb	51
Argon	Ar	18
Arsenic	As	33
Barium	Ba	56
Beryllium	Be	4
Bismuth	Bi	83
Boron	B	5
Bromine	Br	35
Cadmium	Cd	48
Calcium	Ca	20
Carbon	C	6
Cerium	Ce	58

Table 8_4 List of Elements with their atomic numbers, sorted by atomic numbers

Element name	Symbol	Atomic number
Hydrogen	H	1
Helium	He	2
Lithium	Li	3
Beryllium	Be	4
Boron	B	5
Carbon	C	6
Nitrogen	N	7
Oxygen	O	8
Fluorine	F	9
Neon	Ne	10
Sodium	Na	11
Magnesium	Mg	12
Aluminum	Al	13

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Element name	Symbol	Atomic number
Cesium	Cs	55
Chlorine	Cl	17
Chromium	Cr	24
Cobalt	Co	27
Copper	Cu	29
Dysprosium	Dy	66
Erbium	Er	68
Europium	Eu	63
Fluorine	F	9
Gadolinium	Gd	64
Gallium	Ga	31
Germanium	Ge	32
Gold	Au	79
Hafnium	Hf	72
Helium	He	2
Holmium	Ho	67
Hydrogen	H	1
Indium	In	49
Iodine	J (I)	53
Iridium	Ir	77
Iron	Fe	26
Krypton	Kr	36
Lanthanum	La	57
Lead	Pb	82
Lithium	Li	3
Lutetium	Lu	71
Magnesium	Mg	12
Manganese	Mn	25
Mercury	Hg	80
Molybdenum	Mo	42

Element name	Symbol	Atomic number
Silicon	Si	14
Phosphorus	P	15
Sulfur	S	16
Chlorine	Cl	17
Argon	Ar	18
Potassium	K	19
Calcium	Ca	20
Scandium	Sc	21
Titanium	Ti	22
Vanadium	V	23
Chromium	Cr	24
Manganese	Mn	25
Iron	Fe	26
Cobalt	Co	27
Nickel	Ni	28
Copper	Cu	29
Zinc	Zn	30
Gallium	Ga	31
Germanium	Ge	32
Arsenic	As	33
Selenium	Se	34
Bromine	Br	35
Krypton	Kr	36
Rubidium	Rb	37
Strontium	Sr	38
Yttrium	Y	39
Zirconium	Zr	40
Niobium	Nb	41
Molybdenum	Mo	42
Technetium	Tc	43

Element name	Symbol	Atomic number
Neodymium	Nd	60
Neon	Ne	10
Nickel	Ni	28
Niobium	Nb	41
Nitrogen	N	7
Osmium	Os	76
Oxygen	O	8
Palladium	Pd	46
Phosphorus	P	15
Platinum	Pt	78
Potassium	K	19
Praeseodym	Pr	59
Promethium	Pm	61
Rhenium	Re	75
Rhodium	Rh	45
Rubidium	Rb	37
Ruthenium	Ru	44
Samarium	Sm	62
Scandium	Sc	21
Sulfur	S	16
Selenium	Se	34
Silver	Ag	47
Silicon	Si	14
Sodium	Na	11
Strontium	Sr	38
Tantalum	Ta	73
Technetium	Tc	43
Tellurium	Te	52
Terbium	Tb	65
Thallium	Tl	81

Element name	Symbol	Atomic number
Ruthenium	Ru	44
Rhodium	Rh	45
Palladium	Pd	46
Silver	Ag	47
Cadmium	Cd	48
Indium	In	49
Tin	Sn	50
Antimony	Sb	51
Tellurium	Te	52
Iodine	J (I)	53
Xenon	Xe	54
Cesium	Cs	55
Barium	Ba	56
Lanthanum	La	57
Cerium	Ce	58
Praeseodym	Pr	59
Neodym	Nd	60
Promethium	Pm	61
Samarium	Sm	62
Europium	Eu	63
Gadolinium	Gd	64
Terbium	Tb	65
Dysprosium	Dy	66
Holmium	Ho	67
Erbium	Er	68
Thulium	Tm	69
Ytterbium	Yb	70
Lutetium	Lu	71
Hafnium	Hf	72
Tantalum	Ta	73

BETA

Element name	Symbol	Atomic number
Thulium	Tm	69
Titanium	Ti	22
Tungsten	W	74
Vanadium	V	23
Xenon	Xe	54
Ytterbium	Yb	70
Yttrium	Y	39
Zinc	Zn	30
Tin	Sn	50
Zirconium	Zr	40

Element name	Symbol	Atomic number
Tungsten	W	74
Rhenium	Re	75
Osmium	Os	76
Iridium	Ir	77
Platinum	Pt	78
Gold	Au	79
Mercury	Hg	80
Thallium	Tl	81
Lead	Pb	82
Bismuth	Bi	83

The Coating Thickness to be measured/expected it <u>not</u> known

A test measurement can determine the suitability of the isotope used if the coating thickness to be measured/expected is not known.

Required are:
- A sample of the substrate (Base material) and
  a sample of the coating material (Saturation) for normalization.
- A coated specimen for the measurement.

- Set up the application (Menu Function 0, 📖 see also Chapter 6, Page 6-45).

- Switch measurement display to normalized countrate (Xn):
- Call Menu 18, 📖 see also Chapter 6, Page 6-70.
- Select XN; use the softkey CON-FIRM to confirm the selection and exit the menu.

- Normalization:
- Press ZERO,
- enter the number of measurements, Nnorm = 2:
  press the softkey Tnorm Nnorm (Tnorm = 5 sec remains unchanged = default setting),
  press ENTER, the cursor flashes in the lower entry window,
  use the keypad to enter the number 2,
  confirm the entry with the softkey CON-FIRM,

BETA

- measure 2 times on the substrate. Start each measurement with the softkey START or with the GO key at the measuring table. Reposition the specimen after each measurement.
- Measure 2 times on the coating material. Start each measurement with the softkey START or with the GO key at the measuring table. Reposition the specimen after each measurement.
- End the normalization with the softkey CONFIRM.

- Perform 5 measurements on the coated specimen. Start each measurement with the softkey START or with the GO key at the measuring table. Reposition the specimen after each measurement.

Isotope suited if $0.3 < \overline{X}n < 0.8$

$0.3 < \overline{X}n < 0.8$	The selected isotope is suitable for the application.
$0.0 < \overline{X}n < 0.3$	The selected isotope has limited suitability for the application. Use an isotope with lower energy.
$0.8 < \overline{X}n < 1.0$	The selected isotope is not suited for the application. Use an isotope with higher energy.
$\overline{X}n > 1$ or $\overline{X}n < 0$	The coating does not correspond to the sample of the coating material, or the calibration standards used were incorrect.

9 Electrical Conductivity Measurement

This chapter deals with the factors that influence the electrical conductivity measurement:

- The temperature of the specimen
- The distance between the measurement probe and the specimen (Lift-Off-Effect)
- The geometric form of the specimen (curvature, diameter of the test area, thickness of the specimen)

Sections of the Chapter

9.1 Temperature Influence on the Electrical Conductivity Measurement

Temperature is the most significant influencing factor for electrical conductivity measurements. The temperature influence for the various materials can be expressed by a so-called temperature coefficient (α). You can find temperature coefficients listed for various materials in various technical publications (e.g., R. C. McMaster, P. McIntire, M. L. Mester: Nondestructive Testing Handbook; USA: American Society for Nondestructive Testing).

The physical correlation between the electrical conductivity and the temperature of the specimen is shown in the following equation:

$$C = C_{20} / [1 + \alpha(T - 20\ °C)]$$

where:

C:	electrical conductivity in MS/m
C_{20}:	electrical conductivity at 20 °C
T:	current temperature of the specimen
α:	temperature coefficient for the electrical conductivity in 1/°C

Example

For Cu, with an electrical conductivity of 58 MS/m (100 % IACS) at 20 °C, a temperature increase of, for instance, 1 °C will cause a decrease of the electrical conductivity of 0.23 MS/m; correspondingly, for 100 % IACS a reduction of 0.4 % IACS.

With a typical repeatability of 0.2 %, differences in the specimen temperature of only 0.5 °C already makes a difference.

Electrical Conductivity Measurement Without Temperature Compensation

The FISCHERSCOPE® MMS® has the ability to measure the electrical conductivity with or without temperature compensation. The decision whether to measure with or without compensation is made when setting up the application. Before switching to normalization from Menu Function 0, the following query will appear:

Select measurement
( ) without temp. correction
(●) with temp. correction

The following sections explain these two measuring modes in greater detail.

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9.1.1 Electrical Conductivity Measurement Without Temperature Compensation

Select "without temp. correction" from the last menu window prior to normalization, if temperature compensation for the electrical conductivity measurement is not desired.

For correct electrical conductivity measurements without temperature compensation, the specimen and the calibration standards must have the same temperature (±1 °C (± 1.8 °F) according to guidelines of the BOEING AIRCRAFT company).

Calibration Standards and Specimens Must Have the Same Temperature.

The values noted on the calibration standard apply to a temperature of +20 °C (68 °F). That is, for accurate measurements, the normalization and corrective calibration should be made at this temperature and the specimen should have a temperature of 20 °C (68 °F) as well. If measurements are made, for instance, at +23 °C (73.4 °F) instead of at +20 °C (68 °F) and if the value noted on the standard (referenced to +20 °C (68 °F)) is entered during normalization, then the result measured on the specimen at 23 °C (73.4 °F) will also be referenced to 20 °C (68 °F). However, the result will not be totally accurate depending on the differences of the respective temperature coefficients (standard, specimen).

9.1.2 Electrical Conductivity Measurement With Temperature Compensation

In the electrical conductivity measurement mode, the MMS® displays both the actually measured value and the electrical conductivity referenced to 20 °C (68 °F).

Select the parameter "with temp. correction" from the last menu window prior to normalization when setting up the application (Menu Function 0), if temperature compensation for the electrical conductivity measurement is desired.

Temperature and Temperature Coefficient of the Specimen Must be Known.

The following data must be known:

- Current temperature of the specimen
- Temperature coefficient of the specimen material

With the current temperature and the temperature coefficient of the specimen material entered (by softkey TEMP ALPHA), the MMS® will reference the measured value to the reference temperature of 20 °C (68 °F) and

SIGMASCOPE®

Electrical Conductivity Measurement With Temperature Compensation
continued

will display this value (σ (20C) or σ (68F)). The reading without temperature compensation will be displayed as well: σ (curr.temp) = xxx.

When making measurements with temperature compensation, the σ-value referenced to 20 °C (68 °F) can be measured at any temperature, as long as it is known.

9.2 Lift-Off-Effect

Non-Conducting Coatings of up to 600 µm are Lift-Off-Compensated.

Another factor influencing the electrical conductivity measurement is the distance between the probe and the specimen. This factor is referred to as Lift-Off-Effect. It occurs with specimens that are coated, for instance, with paint or other non-conductive coatings. A suitable probe design and appropriate mathematical treatment of the probe signal correct this effect almost entirely.

Within a distance of up to 600 µm (24 mils), the Lift-Off-Effect generally does not affect the MMS® measurement.

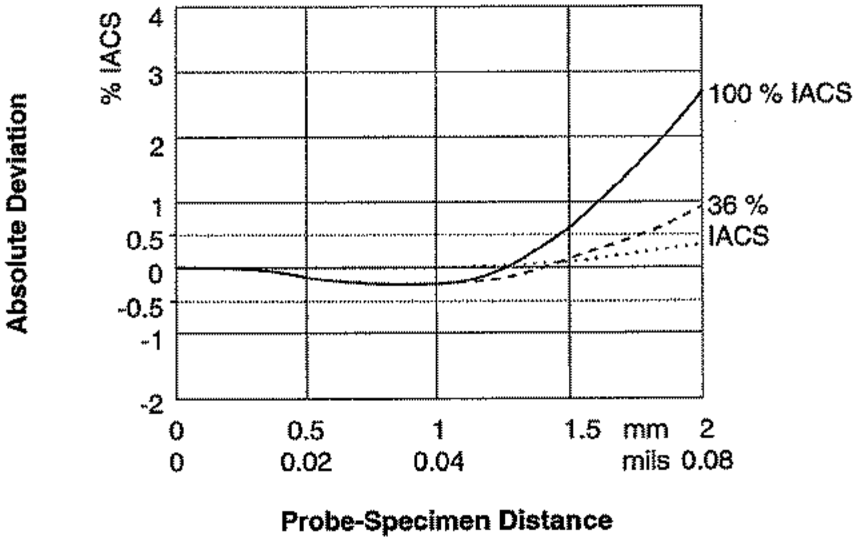

Fig. 9_1: Influence of the Lift-Off-Effect on the electrical conductivity measurement

☞ It depends on the probe type to which distance a lift-off compensation is possible.

9.3 Geometry of the Specimen

9.3.1 Material Thickness

Depending on the electrical conductivity measurement, the specimen must have a minimum thickness to avoid an influence on the reading. Table 9_1 shows the minimum thicknesses (Th_s) of some materials.

Material	El. Conduct.		mm Th_s mils (68 kHz, ES1A)		mm Th_s mils (300 kHz, ES2)	
	MS/m	% IACS	mm	mils	mm	mils
Cu	58	100	0.66	26.4	0.31	12.4
Al	35.4	61.0	0.84	33.6	0.40	16.0
	17	29.3	1.22	48.8	0.58	23.2
Brass	14.3	24.6	1.33	53.2	0.63	25.2
Titanium	2.4	4.1	3.24	129.6	1.54	61.6

Tab. 9_1: Minimum Material Thicknesses for Some Materials

The standard penetration depth is a known quantity in the theory of eddy current testing:

$$\delta_f = \frac{503}{\sqrt{(C \text{ x } f)}}$$

δ_f: Standard penetration depth in mm
C: Electrical conductivity in MS/m
f: Frequency in Hz

Minimum Material Thickness $Th_s = 2{,}6 \text{ x } \delta_f$

The minimum material thickness (Th_s), also known as saturation thickness, where an increase in thickness will have no significant effect on the electrical conductivity reading can be calculated according to the following equation:

$d_s = 2{,}6 \ x \ \delta_f$ mm (according to ASTM E 1004-84)

Measures for Specimen Thicknesses $< d_s$

A relatively accurate measurement is possible even if the thickness is less than the limit Th_s. The specimen is placed on a sufficiently thick non-ferromagnetic metal piece with an electrical conductivity that is similar to the one of the specimen. To obtain correct measurements with sheet metal specimens, the sheets may be "stacked" to reach the saturation thickness.

The next page shows the relationship between the material thickness and the deviation of the electrical conductivity readings for probes with 68 kHz and 300 kHz.

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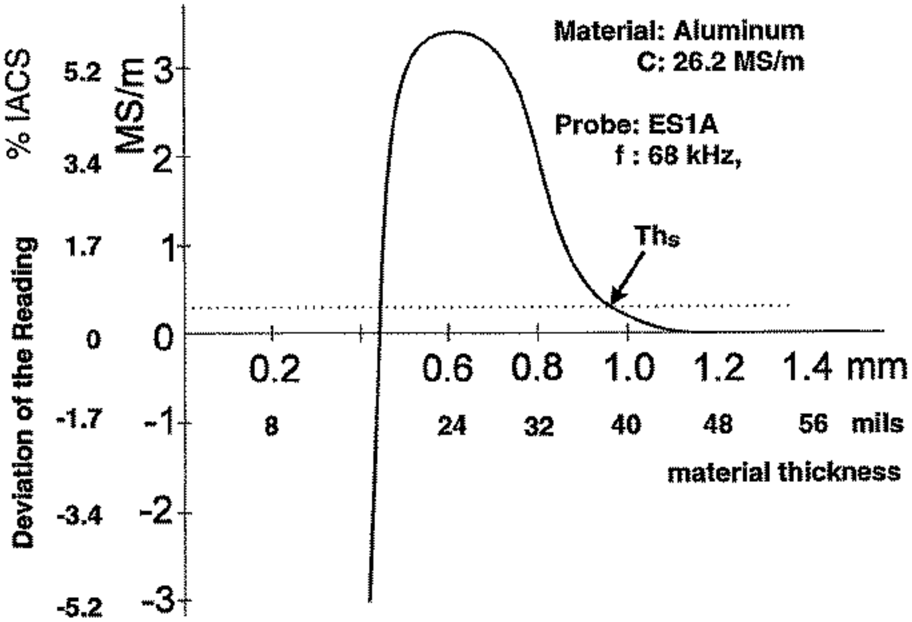

Fig. 9_2: Influence of the material thickness on the electrical conductivity measurement with the probe ES1A (68 kHz).

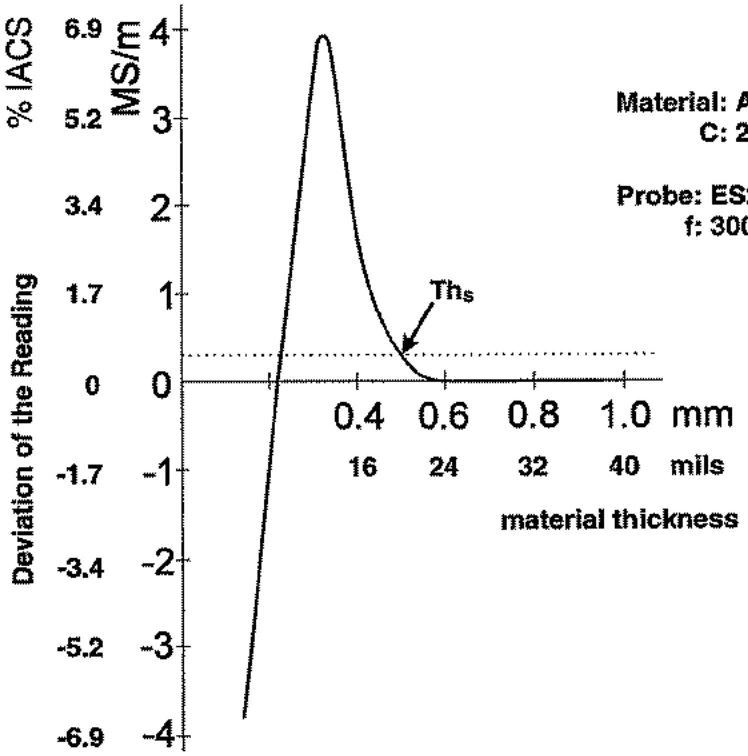

Fig. 9_3: Influence of the material thickness on the electrical conductivity measurement with the probe ES2 (300 kHz)

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9.3.2 Curvature of the Specimen

Measurements may be erroneous if the measurements are made on curved specimens. Measurements made on convex surface curvature result in lower electrical conductivity readings than measurements on the same material but on flat surfaces. With concave surface curvature, the influence goes in the other direction. That is, the electrical conductivity reading is higher than the reading on flat measurement surfaces.

The influence of the curvature becomes recognizable with curvature diameters of < 60 mm (2.4") (convex surfaces) or < 120 mm (4.7") (concave surfaces) respectively.

The following diagram shows the factor that the reading needs to be multiplied with to receive the actual electrical conductivity value of the material. The diagram illustrates the correction factors for convex surfaces.

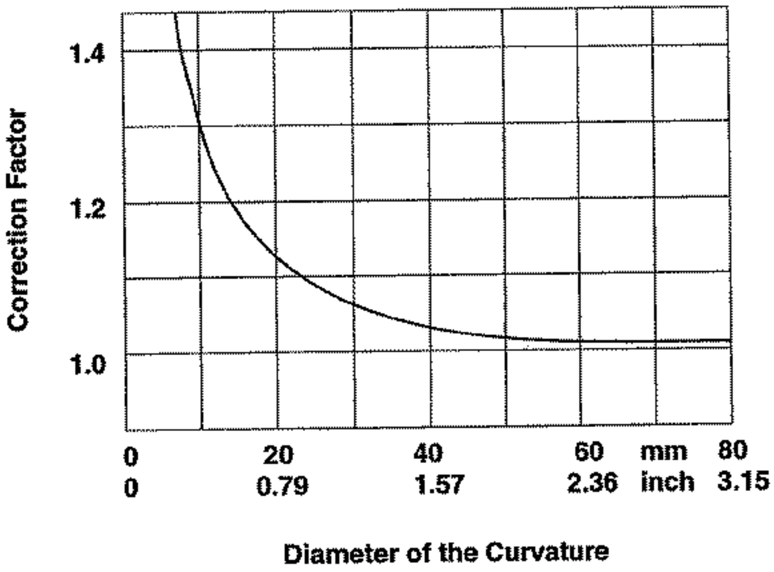

Fig. 9_4: Influence of convex surface curvature on the electrical conductivity measurement

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9.3.3 Edge Effect, Size of Test Area

The influence of the distance (a) between the outer diameter of the probe and the edge of the specimen is known as edge effect. This distance should be ≥ 3 mm (0.12").

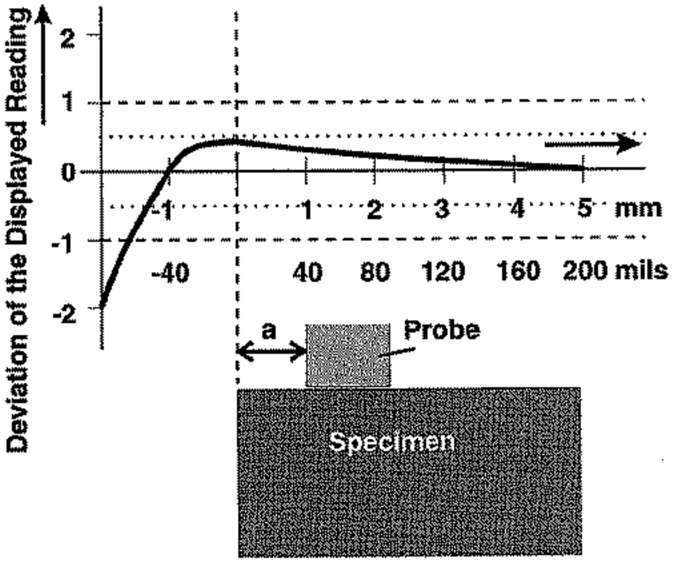


Fig. 9_5: Influence of the Edge Effect on the Electrical Conductivity Measurement for a large-area test area

The following general equation can be used to calculate the minimum test area for circular specimen: $d_{min} = d_{probe} + 1\,cm\,(0.39\,'')$

d_{min}: Diameter of the minimum test area where the edge effect has no influence

d_{probe}: Probe diameter (14 mm (0.55") for ES1A, 9 mm (0.35") for ES2)

The probe must, of course, be placed in the center of the test area.

10 Ferrite Content Measurement

FERITSCOPE®

This chapter deals with the factors that influence the ferrite content measurement:

- The geometric form of the specimen (curvature, thickness of the specimen)
- Austenitic clad layers on ferritic steel or iron parts

Sections of the Chapter

FERITSCOPE®

10.1 Influence of the Specimen Curvature

If the specimen is curved, the reading will deviate from the actual value as the curvature increases (starting with a curvature diameter of approx. 50 mm (2 ")). Correction factors can be used to correct the influence of the specimen curvature.

The following relation exists between the ferrite content and the diameter of the specimen curvature:

$$\text{Ferrite}_t = \text{Correction Factor x Ferrite}_m$$

Ferrite_t = true ferrite content
Ferrite_m = measured ferrite content

The curves in Fig. 10_1 show that curvatures with diameters of ≥ 50 mm (2 ") have a negligible influence.

Example: A ferrite content of 30 % is measured on a cylindrical surface with a diameter of 20 mm (0.79 "). The true ferrite content can be calculated as follows:

Ferrite_t = 1.04 x 30 % = 31.2 %

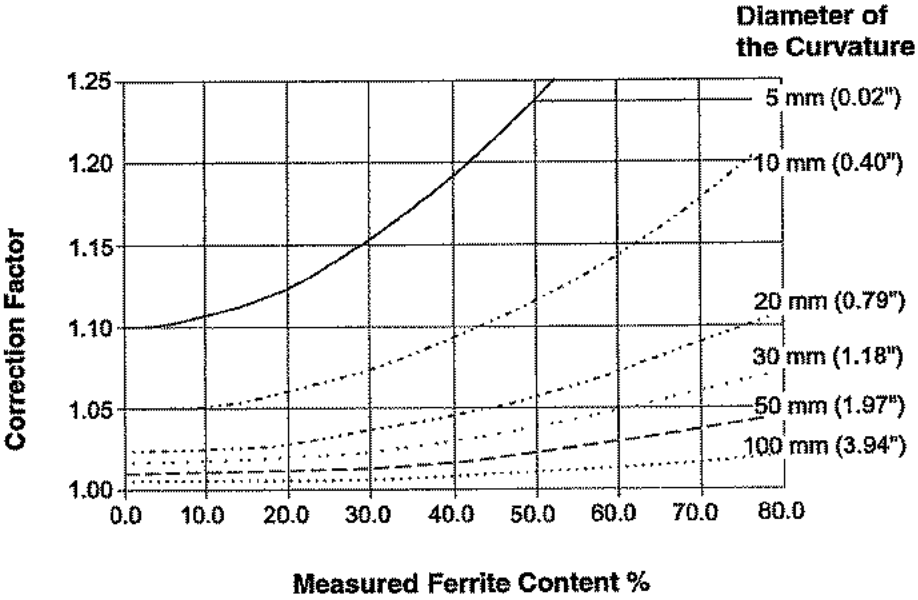


Fig. 10_1: Influence of the Specimen Curvature on the Ferrite Content Measurement

10.2 Influence of the Specimen Thickness

Sheet metal thickness may influence the ferrite content measurement. This influence becomes noticeable with sheet thicknesses of ≤ 2 mm (0.08"), as shown in Fig. 10_2. The following relation exists:

$$\text{Ferrite}_t = \text{Correction Factor x Ferrite}_m$$

Ferrite_t = true ferrite content
Ferrite_m = measured ferrite content

Example: A ferrite content of 6 % is measured on a metal sheet with a thickness of 1 mm (0.04 "). The true ferrite content is calculated as follows:

$\text{Ferrite}_t = 1.05 \text{ x } 6\ \% = 6.3\ \%$

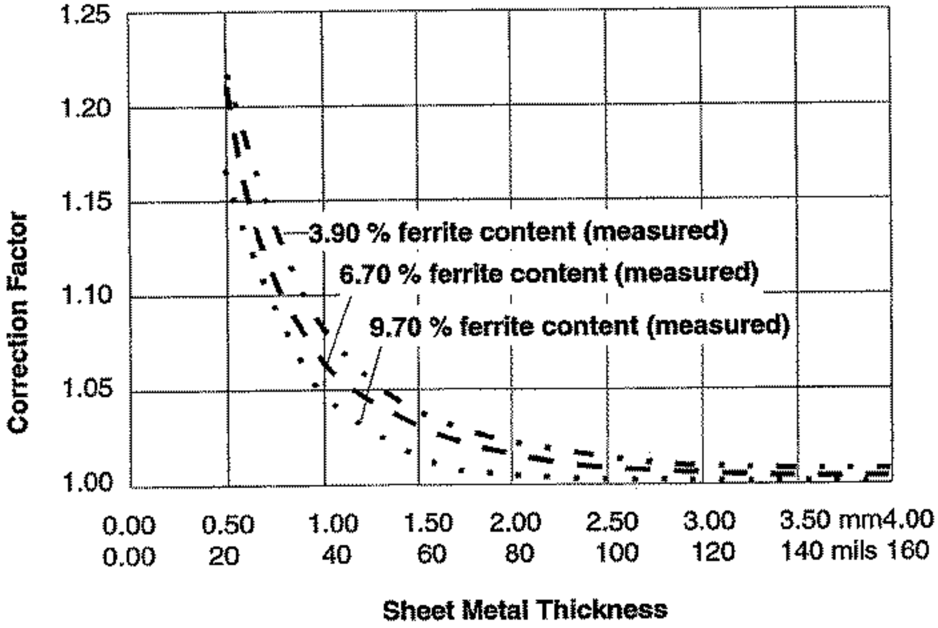


Fig. 10_2: Influence of the sheet metal thickness on the Ferrite Content Measurement

10.3 Substrate Influence on the Ferrite Measurement for Austenitic Layers

When making ferrite content measurements on austenitic layers on ferromagnetic steel, the readings are influenced by the layer thickness. This influence becomes noticeable for layer thicknesses starting at ≤ 2 mm (0.08"), as shown in Fig. 10_3. The following relation exists:

$$\text{Ferrite}_t = \text{Corrective Factor x Ferrite}_m$$

Ferrite_t = true ferrite content
Ferrite_m = measured ferrite content

Example: A ferrite content of 6 % is measured on an austenitic layer with a thickness of 1 mm (0.04 "). The true ferrite content is calculated as follows:
$\text{Ferrite}_t = 0.85 \text{ x } 6\ \% = 5.1\ \%$

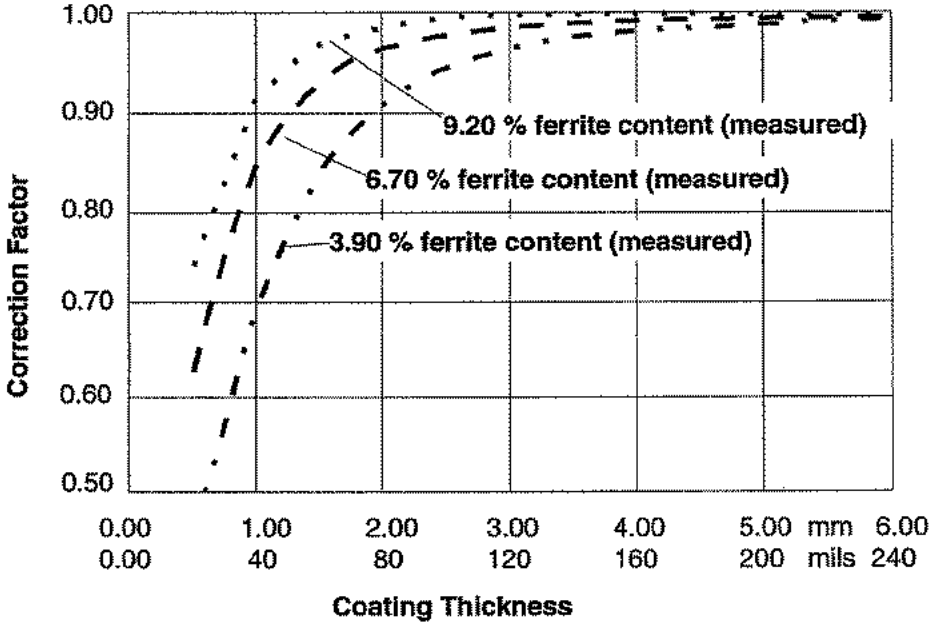


Fig. 10_3: Substrate Influence on the δ-Ferrite Measurement for Austenitic Layers

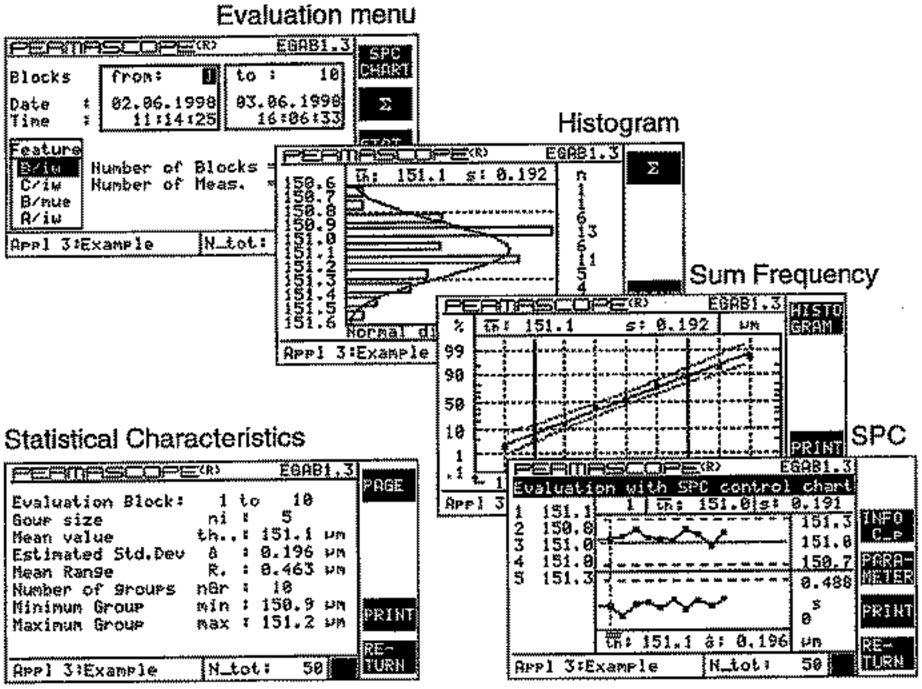
11 Evaluation

The FISCHERSCOPE® MMS® saves the user from having to do the sometimes complicated and extensive mathematical computations for the statistical evaluation of the measurement data. The evaluation is performed separately for each block and or over a selection of blocks. The statistical characteristics can be viewed and printed from an evaluation menu. Presentation modes such as SPC chart, sum frequency chart (normal probability chart) and histogram are part of the standard instrument configuration and can be called from the evaluation menu.

For a description of the statistical terms as well as the formulas and formula signs used see the Glossary, Chapter B.

For additional information regarding the various statistical methods and regarding the probability calculations, we would like to refer to the respective technical literature. A detailed description would be beyond the scope of this manual. You can find some references in the bibliography at the end of this chapter.

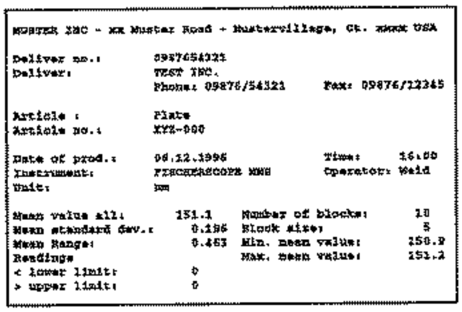
Display Modes (Examples)



```
Blocks      from:     1   to :      10
Date    :   02.06.1998    03.06.1998
Time    :     11:14:25      16:06:33
Feature
 B/iw       Number of Blocks =
 C/iw       Number of Meas.
 B/mue
 A/iw
Appl 3:Example          N_tot:
```

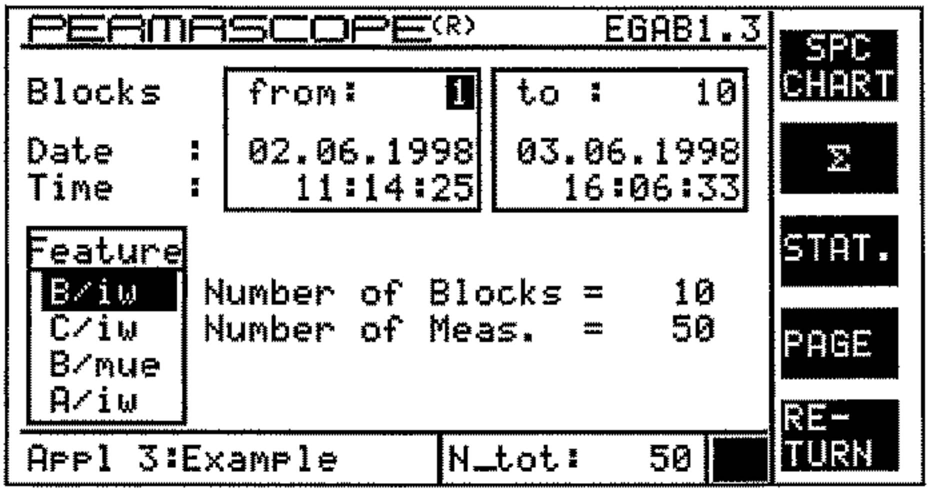
```
Evaluation Block:    1 to   10
Gour size           ni  :   5
Mean value          th..: 151.1 µm
Estimated Std.Dev   ŝ   : 0.196 µm
Mean Range          R.  : 0.463 µm
Number of groups    nGr :  10
Minimum Group       min : 150.9 µm
Maximum Group       max : 151.2 µm
Appl 3:Example          N_tot:    50
```

Sample of a printout using a printform template



```
MUSTER INC - xx Muster Road - Mustervillage, Ct. xxxxx USA

Deliver no.:          0987654321
Deliver:              TEST INC.
                      Phone: 09876/54321      Fax: 09876/12345

Article :             Plate
Article no.:          XYZ-000

Date of prod.:        06.12.1996              Time:       16:00
Instrument:           FISCHERSCOPE MMS        Operator: Weid
Unit:                 µm

Mean value all:          151.1    Number of blocks:        10
Mean standard dev.:        0.196  Block size:               5
Mean Range:                0.463  Min. mean value:      150.9
Readings                          Max. mean value:      151.2
< lower limit:             0
> upper limit:             0
```

11.1 Evaluation Menu



```
PERMASCOPE(R)                EGAB1.3
Blocks        from:     1   to :      10
Date     :    02.06.1998    03.06.1998
Time     :      11:14:25      16:06:33
Number of Blocks =    10
Number of Meas.  =    50
Appl 3:Example           N_tot:     50
```

Example

The evaluation menu is the starting point for the statistical evaluation and for the evaluation printout. The graphical evaluation menus and the menus with the statistical data are called from these menus. Softkeys are used to call the menus.

The following pages describe the following evaluation modes in greater detail:

- SPC chart, enter SPC parameters, calculate the control limits, call the SPC characteristics, description of the SPC display mode, beginning on Page 11-4,
- Sum frequency diagram (probability chart), beginning on Page 11-12.
- Histogram, beginning on Page 11-14.
- Statistical characteristics (final result), beginning on Page 11-16.
- Evaluation of blocks, beginning on Page 11-17.

The second menu page of the evaluation menu contains the softkeys for data transfer, for example, to a computer, and for the printout.

For more information regarding printing of measurement data see Chapter 6, beginning on Page 6-28.

For more information regarding data transfer via the RS232 interface see Chapter 12.

Call the evaluation menu

☞ The menu can only be called from the measurement mode.

- Press the softkey EVAL-UATE.

Call the Evaluation Menu:
EVAL-UATE

Exit the evaluation menus

- To exit the evaluation menu use softkey RE-TURN.
  If necessary, press the key several times until the measuring mode appears on the display. The softkey RE-TURN disappears from the measuring mode.

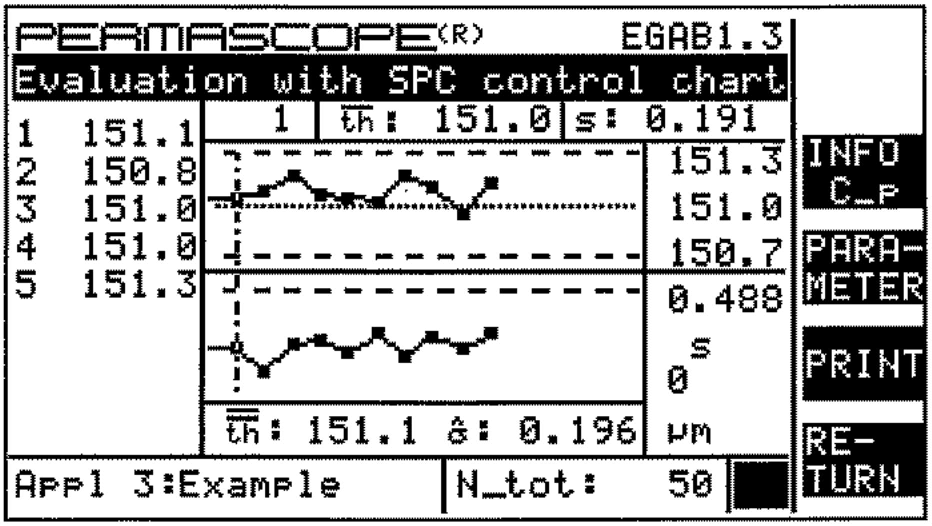
Exit the Evaluation Menu:
RE-TURN

11.1.1 Block Selection

- An evaluation can be performed for one block, across a number of consecutive blocks, across all blocks, and/or across blocks with the same feature (name) of the active application.
  Example for a block selection: from block number 3 to block number 7. This means that the evaluation (graphical display and calculation) is performed only for the specified blocks - that is, across 5 blocks in this example. The measurement data of the remaining blocks do not enter the evaluation.
- Enter the block numbers in the evaluation menu: 0 ... 9.
- Switch between entry/selection windows: ENTER.
- Select the feature from the list: ▼2 or ▲8 and CON-FIRM.

11.2 Graphical Evaluation

11.2.1 SPC Chart



Evaluation with SPC control chart

1 $\bar{t}h$: 151.0 s: 0.191

1 151.1
2 150.8
3 151.0
4 151.0
5 151.3

$\bar{\bar{t}}h$: 151.1 $\hat{\sigma}$: 0.196

Appl 3:Example

N_tot: 50

Example

Data for process control are presented clearly in an SPC chart. The control charts evaluate the forthcoming progress, the shift and the random deviation range of a process. The control limits define the outermost limits for acceptable values. The control limits can be computed by the MMS® instrument or entered via the keypad according to company-specific specifications.

Here, the progress can be over freely selectable groups of measurements (blocks), contrary to SPC chart display in the measuring mode.

For the measurement display mode SPC Chart see Chapter 5, beginning on Page 5-16.

Prerequisite:

- A minimum of one closed group (block) with two measurements ($n \geq 2$) must be available.
- To calculate the control limits from a so-called pre-run, a minimum of 5 groups each with at least 2 measurements is required.
- The smallest group size is 2, the largest is 9.
- A normal distribution is required to apply the method of statistical process control. For the process, this means:
  - a low and event deviation ($\hat{\sigma}$) around the mean measurement value (d.., σ.., Fe..),
  - an even distance of the mean measurement value to the control limits.

  It is, therefore, advantageous to run a pre-measurement and check the frequency distribution. The FISCHERSCOPE® MMS® offers

SPC Chart (continued)

EVAL-UATE SPC CHART

appropriate functions in the evaluation menu (sum frequency chart Σ and histogram HISTOGRAM).

Call from the measuring mode:

- Press the softkey EVAL-UATE and then SPC CHART to display the menu page "Evaluation with SPC control chart".

  Dual Coating Measurement Application SIGMA (DUPLEX)

  Dual coating measurement application (Duplex): Each coating is displayed in an SPC chart. To call the SPC charts for the individual coatings use the softkey 1. or 2..
  1. displayed: Temporarily, the display for coating 2 (intermediate coating) appears,
  2. displayed: Temporarily, the display for coating 1 (top coating, paint coating) appears.

Printing

☞ To **print** the SPC chart display use the softkey PRINT.

☞ Each **group** in the SPC chart can be **selected** with the cursor (dash-dot line) (◀4, 6▶).

11.2.1.1 Enter the SPC Parameters:

Enter SPC Parameters

EVAL-UATE SPC CHART PARA-METER

☞ Does usually not apply to applications with measurement display mode SPC chart. The set parameters are entered automatically.

Call: from the menu page "Evaluation with SPC control chart".

- Press the softkey PARA-METER to open the menu page "Enter SPC Parameters" to enter the SPC parameters for the SPC chart to be displayed.
  Use the keypad to enter the parameters: 0 ... 9.
  Switch between the entry windows with ENTER.

☞ **Dual coating measurement application:** The SPC parameters must be entered/calculated separately for each coating.

☞ **Group size: If automatic block creation is enabled,** the block size entered (in menu function 0 or 1) automatically corresponds to the group size (n) for the SPC chart. In this case, the group size cannot be changed!

☞ **Group size:** The group size (n) can be specified only when **automatic block creation is disabled.** The group size must be ≤ the block size. An SPC chart evaluation will not be performed if the group size is greater.
If the group size is smaller than the block size, then as many groups as possible will be created for each block. However, the number of measurements that cannot form a group to the end of the block based on the specified group size do not enter the evaluation. Example: An application has 50 measurements and a block was closed manually after every fifth measurement. For the SPC chart evaluation, the group size is set to 3. Measurements 1 to 3 of the first block form group 1 for the SPC chart. The measurements 4 and 5 are omitted because they cannot form a separate group within the first block. These measure-

SPC Chart
(continued)

EVAL-UATE SPC CHART PARA-METER

ments do not enter the SPC chart evaluation! The same applies to all subsequent blocks (2 to 10).

SPC Parameters (Menu page: Enter SPC Parameters)	
Group size, number of single readings per group. ☞ See 2nd and 3rd note on previous page.	n
$\bar{x}$ ($\overline{th}$) chart and R chart display	X./R
$\bar{x}$ ($\overline{th}$) chart and s chart display	X./s
The specification limits USL and LSL as well as the capability factor Cp are taken into consideration for the statistical SPC chart characteristics. The control limits are computed automatically when these data are entered.	specification limits
* Lower control limit for the $\bar{x}$ ($\overline{th}$) chart	LCL
* Upper control limit for the $\bar{x}$ ($\overline{th}$) chart	UCL
* Upper control limit for the R chart	UCL(R)
* Upper control limit for the s chart	UCL(s)
** Lower specification limit Limits already entered for the application will be entered automatically.	LSL
** Upper specification limit Limits already entered for the application will be entered automatically.	USL
** Cp value (capability factor). Ideal value: 1.33.	Cp

* The control limits can be entered if "specification limits" is switched off (disabled).

** Specification limits (USL, LSL) and Cp value can be entered and displayed only if "specification limits" is switched on (enabled).

For a description of the statistical terms as well as the formulas and formula signs used see the Glossary, Chapter B.

- Accept the entries/settings with the softkey CON-FIRM. Return to the menu page "Evaluation with SPC control chart".

11.2.1.2 Calculating the Control Limits:

Calculate Control Limits

EVAL-UATE SPC CHART PARA-METER

There are two ways available for calculating the control limits with the FISCHERSCOPE® MMS®:

- ASTM MNL-7 (ASTM: American Society for Testing and Materials; American standard ASTM publication MNL-7, Manual on Presentation of Data and Control Chart Analysis, 6th Edition (ISBN 0-8031-1289-0)) .
- DIN (Calculation according to the quality control chart technology of the 'Deutsche Gesellschaft für Qualität e. V.' (German Quality Society)).

Use menu function 39 to select which formula should be used for calculating the control limits.

A description of menu function 39 see Chapter 6, page 6-103.

For a description of the statistical terms as well as the formulas and formula signs used see the Glossary, Chapter B.

- Call the evaluation menu: EVAL-UATE.
- Call the menu page "Evaluation with SPC control chart": SPC CHART.
- Call the menu page "Enter SPC Parameters": PARA-METER.

If the control limits are not known, proceed as follows depending on the available data:
- Available data: specification limits (USL, LSL) and process capability factor (Cp), Page 11-7.
- Available data: Data from pre-run, Page 11-8.
- Available data: Process mean value (x..) and estimated value for the standard deviation ($\hat{\sigma}$) or for the mean range R., Page 11-9

Available data: specification limits (USL, LSL) and capability factor (Cp)

- Enable the Parameter "Specification Limits": ON OFF.
  Entry boxes for LSL, USL and Cp value will appear.

☞ If values have already been entered for the active application, limits already specified will be transferred automatically from the application. The Cp value is automatically set to 1.33.

- Enter the desired values: 0 ... 9.
  To switch between the entry boxes: ENTER.

Calculate Control Limits
(continued)

EVAL-UATE SPC CHART PARA-METER

- **Calculation:** After entering the numbers for LSL and USL press the ENTER key to calculate the control limits (LCL, UCL, UCL(s) or UCL(R) on the left side of the display).

Changing LSL, USL and/or Cp:

- Make the desired changes on the menu page "Enter SPC Parameters"
(0 ... 9, ENTER). After entering the numbers, press the ENTER key to recalculate the parameters.

Changing LCL, UCL, UCL(s) and UCL(R), x.. (≡ $\bar{\bar{th}}$) and/or $\hat{\sigma}$:

- Press the softkey ADVAN-CED to open the menu page "Calculation of control limits" and make the desired changes. After entering the numbers, press the ENTER key to re-calculate the parameters.

- Accept the entries/settings as SPC parameters with the softkey CON-FIRM. Return to the menu page "Evaluation with SPC control chart".

  To return to the measuring mode: Press RE-TURN 2 times.

Available data: Pre-run (pre-measurement)

☞ A minimum of 5 groups each with a minimum of 2 measurements - that is, a total of 10 measurement data - must be available to calculate the control limits from a so-called pre-run.

☞ The parameter "Specification Limits" **must** be disabled (= [ ]).

- On the menu page "Enter SPC Parameters", press the softkey FORE-RUN. The control limits will be calculated automatically using the pre-run values.

Changing LCL, UCL, UCL(s) and UCL(R):

- Use the menu page "Enter SPC Parameters" to make the desired changes
(0 ... 9, ENTER). After enter the numbers, press the ENTER key to re-calculate the parameters.

Calculate Control Limits
(continued)

EVAL-UATE SPC CHART PARA-METER

Changing x.. (≡ $\overline{\overline{th}}$) and/or $\hat{\sigma}$:

- Press the softkey ADVANCED to open the menu page "Calculation of control limits" and make the desired changes (0 ... 9, ENTER). After entering the numbers, press the ENTER key to re-calculate the parameters.

- Accept the entries/calculations as SPC parameter with the softkey CON-FIRM. Return to the menu page "Evaluation with SPC control chart.

  To return to the measuring mode: Press RE-TURN 2 times.

Available data:
Process mean value (x.. ≡ $\overline{\overline{th}}$) and standard deviation ($\hat{\sigma}$)

- Press the softkey ADVANCED to open the menu page "Calculation of control limits" and make the desired entries. After entering the numbers, press the ENTER key to re-calculate the parameters.

- Accept the entries/calculations as SPC parameters with the softkey CON-FIRM. Return to the menu page "Evaluation with SPC control chart.

  To return to the measuring mode: Press RE-TURN 2 times.

SPC Characteristics Process Capability

EVAL-UATE **SPC CHART** **INFO C_p**

11.2.1.3 Call the SPC Characteristics:

Call: Only from the menu page “Evaluation with SPC control-chart”.

- Press the softkey **INFO C_p** to open a menu window with the statistical characteristics for the displayed SPC chart.

Statistical characteristics of the SPC chart	Coating thickness	Conductivity	Ferrite content
Averaged group mean values	th..	σ..	Fe..
Group deviation range (th..,) (only when autom. block creation is enabled)	sa		
Group size, number of single readings per group	n		
Number of groups	nGr		
Lower set specification limit	LSL		
Upper set specification limit	USL		
Capability factor	c_p		
Capability factor	c_pk		

Printing

☞ To print the statistical characteristics for the displayed SPC chart use the softkey **PRINT**.

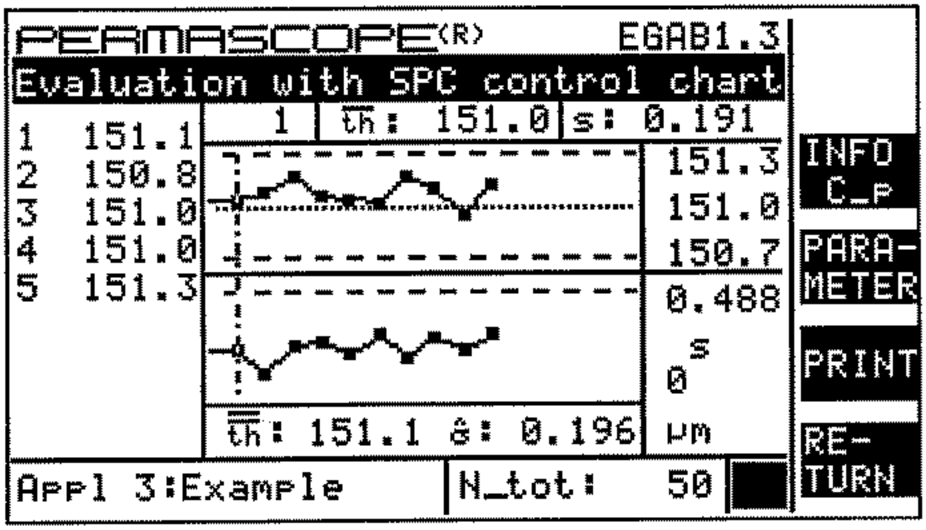
☞ This menu page is for information purposes only. No changes can be made on this page. Changes can be performed only in menu page “Enter SPC Parameters” (**PARA-METER**).

For a description of the statistical terms as well as the formulas and formula signs used see the Glossary, Chapter B.

- To return to the SPC chart display (menu page “Evaluation with SPC control chart”) use the softkey **CON-TINUE**.

11.2.1.4 Description of the Display:

SPC Chart
(continued)



PERMASCOPE(R) EGAB1.3

Evaluation with SPC control chart

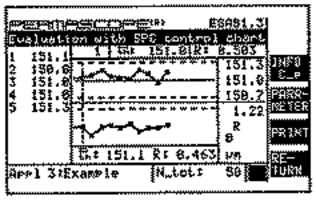
1 151.1
2 150.8
3 151.0
4 151.0
5 151.3

1 | $\overline{\text{th}}$: 151.0 | s: 0.191

$\overline{\overline{\text{th}}}$: 151.1 $\hat{\sigma}$: 0.196 µm

Appl 3:Example | N_tot: 50

Example X./s chart



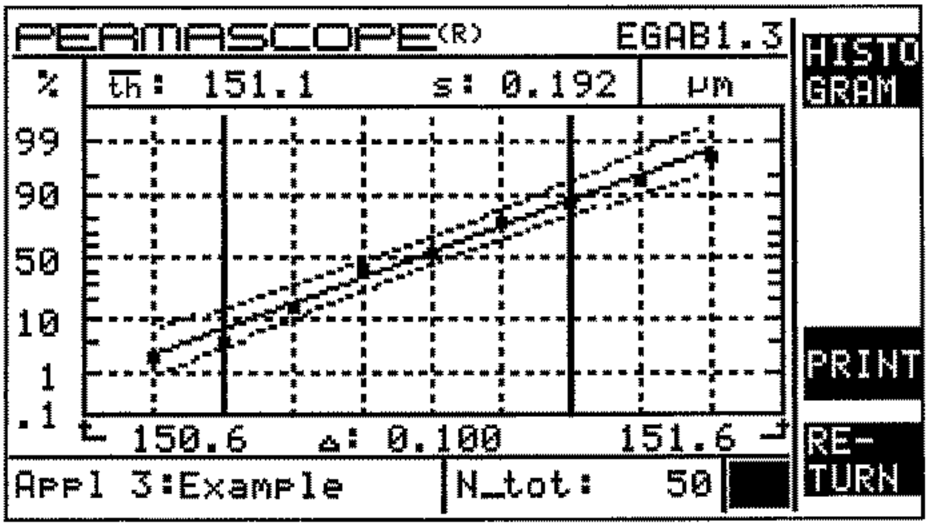
Example X./R chart

Control charts display the mean value ($\overline{\text{th}}$) and the range (R) of successive random samples, or the mean value ($\overline{\text{th}}$) and the standard deviation (s). The upper section of the display shows the $\bar{x}$ chart ($\overline{\text{th}}$ chart), the s- or R charts are displayed in the lower section. The control limits UCL and LCL for the $\bar{x}$ chart and UCL(R) for the R chart, or UCL(s) for the s chart are shown as dashed lines in the charts.
Display resolution and size allow only for a rough presentation. The printout of the SPC chart offers a better resolution.

For process control, random samples are continuously taken from the running production process, if possible in equal time intervals. For each random sample, consisting, for example, of 5 parts (= group size), the mean value is plotted in the $\bar{x}$ chart (and depending on the display mode, the range (R) or the standard deviation is entered into the R or the s chart). To evaluate the process, control limits must be shown in the SPC chart. The control limits can be either entered or they can be calculated. The FISCHERSCOPE® MMS® calculates the control limits according to the American standard ASTM publication MNL-7, Manual on Presentation of Data and Control Chart Analysis, 6th Edition (ISBN 0-8031-1289-0) or according to the quality control chart technology of the 'Deutsche Gesellschaft für Qualität e. V.' (German Quality Society)).

For additional information regarding the SPC chart see Chapter 5, beginning on Page 5-16.

11.2.2 Sum Frequency Chart (Probability Distribution Chart)



th: 151.1 s: 0.192 µm

Δ: 0.100

Appl 3:Example N_tot: 50

Example Sum Frequency Chart

Sum Frequency Chart

EVAL-UATE Σ

Min. 5 Measurements

The sum frequency chart is a graphical display format from which the outlier portion of a batch (lot, production series) can be estimated. Using the sum frequency chart, the lower violation probability and the related confidence range can be viewed for a coating thickness value, or the coating thickness value for a certain lower violation probability.

Prerequisite:

- A minimum of 5 measurements per coating ($n \geq 5$) must be available for graphical measurement data display in a sum frequency chart.
- $5 \leq n < 30$ (per coating): The sum frequency values are plotted in reference to the single readings. The Kolmogoroff-Smirnoff Test is used to test for normal distribution of the measurements.
- $n > 30$ (per coating): The sum frequency values are plotted in reference to the classes. In addition, the confidence range (error cone) is shown for a confidence level of 95 %. The Chi Squared Test is used to test for normal distribution of the measurements.

  ☞ A histogram display can be opened for 30 or more measurements.
- If there is no normal distribution, the instrument will automatically determine a correction line.
- If there is no normal distribution, a correction curve is plotted automatically in the chart and skewness and kurtosis are determined.

For a description of the statistical terms as well as the formulas and formula signs used see the Glossary, Chapter B.

Sum Frequency Chart
(continued)

EVAL-UATE Σ

Call from the measuring mode:

- Press the softkey EVAL-UATE and then Σ to display the probability chart.

Dual Coating Measurement Application SIGMA (DUPLEX)

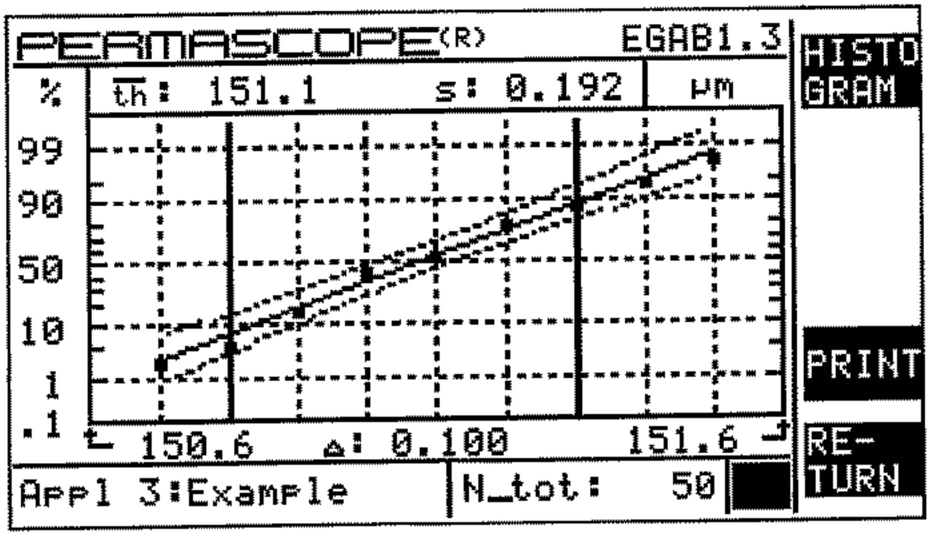
Dual coating measurement application: The sum frequency is determined for each coating and plotted in a sum frequency chart. To call the charts for the individual coatings use the softkey 1. or 2..

1. displayed: Momentarily, the display for coating 2 (intermediate coating) appears,
2. displayed: Momentarily, the display for coating 1 (top coating, paint coating) appears.

Printing

☞ To print the displayed sum frequency chart use the softkey PRINT.

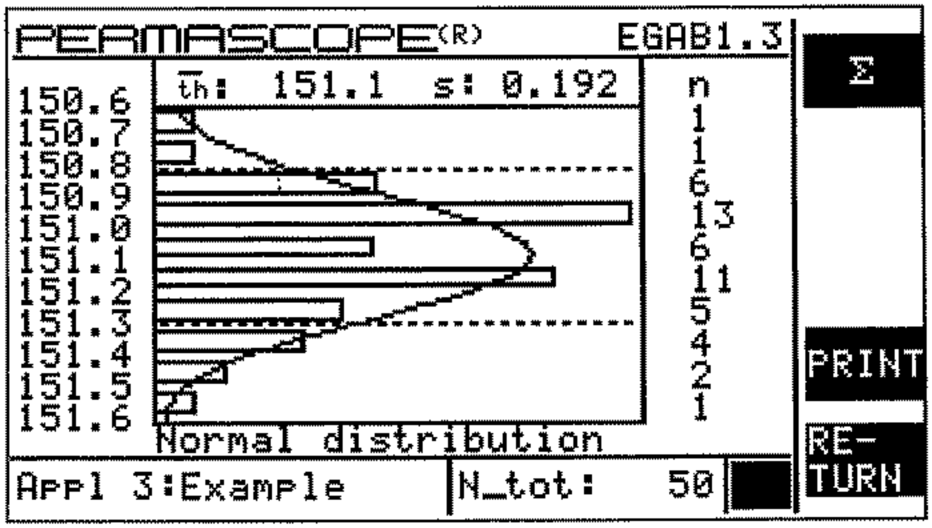
Description of the Display



Example Probability Chart

The sum frequency values (of the random samples) are plotted in a sum frequency chart (Gaussian Probability Paper) and appear as small black squares in the chart. The sum frequency (in %) is plotted on the ordinate (y-axis), and the coating thickness (in µm) on the abscissa (x-axis). Display size and resolution allow only for a rough presentation. The printout of the sum frequency chart offers a better resolution. Additionally, the printout shows the 'u' values of the standardized normal distribution (quantile) on the right ordinate.

11.2.3 Histogram



Example Histogram

Histogram

EVAL-UATE Σ HISTO GRAM

Min. 30 Measurements

A histogram clearly shows the distribution of the measurements according to classes, that is, how many measurements are within a certain coating thickness range.

For a description of the statistical terms as well as the formulas and formula signs used see the Glossary, Chapter B.

Prerequisite:

- A minimum of 30 measurements per coating ($n \geq 30$) are required for the histogram display. The Chi Squared Test is used to test for normal distribution of the measurements.
- The histogram can be called only from the sum frequency chart.

Call from the measuring mode:

- Press the softkey EVAL-UATE, Σ and then HISTO GRAM.

Dual Coating Measurement Application SIGMA (DUPLEX)

Dual coating measurement application: Each coating is displayed in a histogram. To call the histograms for the individual coatings use the softkey 1. or 2..

1. displayed: Momentarily, the display for coating 2 (intermediate coating) appears,

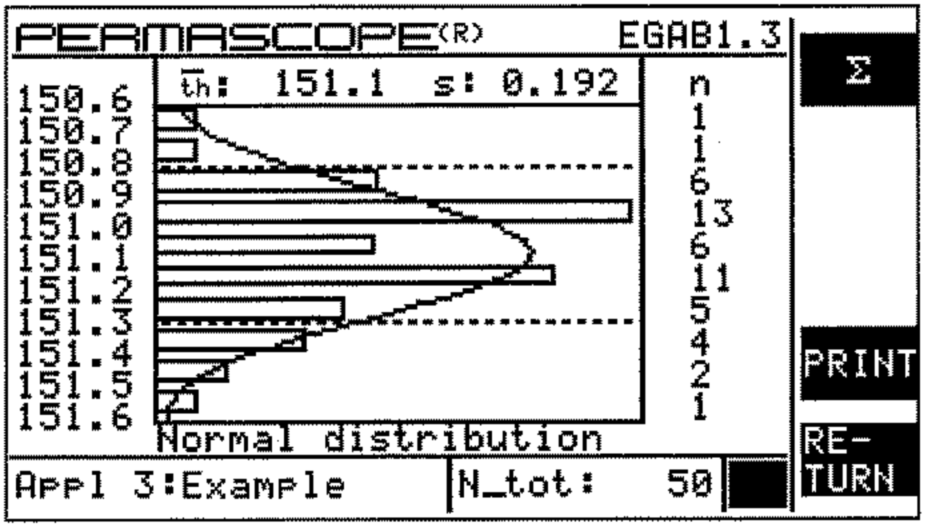
2. displayed: Momentarily, the display for coating 1 (top coating, paint coating) appears.

Printing

☞ To print the histogram use the softkey PRINT.

Histogram
(continued)

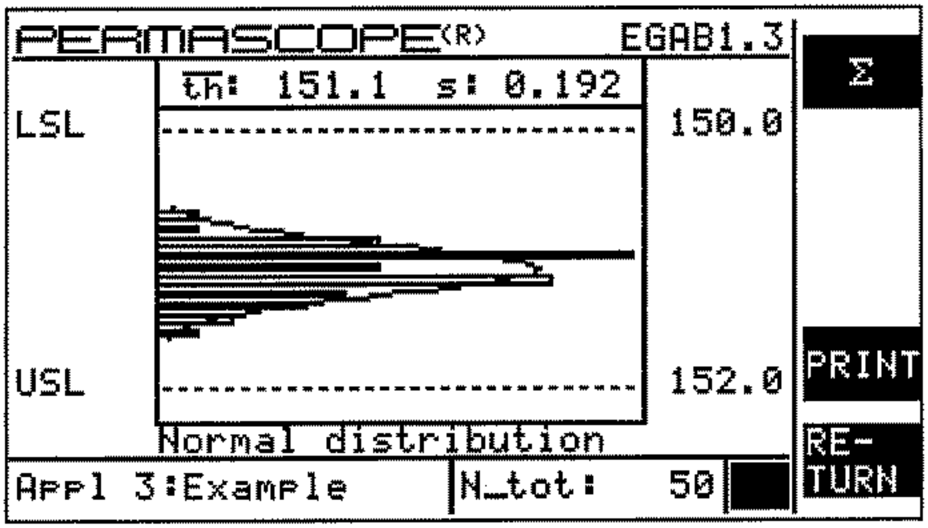
Description of the Display:



Example 1 Histogram

The class borders are shown on the left side and the frequency density on the right side.
The display resolution and size allow only for a rough presentation. The printout of the histogram offers a better resolution. The printout also shows the frequency density in percent and in summary format.

If specification limits (USL, LSL) are specified as SPC parameters (SPC CHART PARA-METER), then the plot display depends on the position of the specification limits LSL and USL as shown in Example 2 below.



Example 2 Histogram

Statistical Characteristics

EVALUATE **STAT.**

11.3 Statistical Characteristics

For a description of the statistical terms as well as the formulas used see the Glossary, Chapter B.

The FISCHERSCOPE® MMS® calculates the following characteristics:

Evaluation over several single readings (BLOCK RESULT)	Coating thickness	Conductivity	Ferrite content
Mean value (block mean value)	th.	σ.	Fe.
Standard deviation	s		
Coefficient of variation	V		
Minimum reading	min		
Maximum reading	max		
Number of measurements used to calculate the characteristics	n		
*Lower specified specification limit	LSL		
*Upper specified specification limit	USL		
*Number of measurements violating the lower limit	Readings < LSL		
* Number of measurements violating the upper limits	Readings > USL		

* Characteristics are shown only if limit monitoring is switched on (enabled).

Evaluation over several blocks/groups (FINAL RESULT)	Coating thickness	Conductivity	Ferrite content
Group size = Number of measurements per group	ni		
Averaged group mean values d.	th..	σ..	Fe..
Estimate for the standard deviation σ of the base total	$\hat{\sigma}$		
Averaged range	R.		
Number of groups evaluated	nGr		
Smallest group mean value of all groups evaluated	Smallest group min		
Largest group mean value of all groups evaluated	Largest group max		
Lower specified specification limit LSL	Lower spec. limit LSL		

Evaluation over several blocks/groups (FINAL RESULT)	Coating thickness	Conductivity	Ferrite content
Upper specified specification limit USL	Upper spec. limit USL		
Number of measurements violating the lower specification limit	Readings < LSL		
Number of measurements violating the upper specification limit	Readings > USL		
Deviation range among the groups (only of automatic block creation is enabled)	sa		
Capability factor	Cp		
Capability factor	Cpk		

Statistical Characteristics

EVALUATE STAT.

☞ The data presented refer to applications where **automatic block creation is enabled**.

☞ The evaluation of an application is always performed per group (block), however, it can be performed across a certain number (freely selectable) of blocks (groups).

11.3.1 Evaluation Across Several Blocks/Groups

Evaluation across several blocks/groups can be performed in two ways:

1. For a number of successive blocks/groups. For example from block number 3 to block number 7. In this case, the evaluation is across 5 blocks/groups. 🗐 Page 11-18.

2. For a number of blocks/groups with the same feature. 🗐 Page 11-19.

Prerequisite:

- The application to be evaluated must be active and in measuring mode.

Evaluation from Block x to Block y

EVAL-UATE

1. Evaluation across a number of successive blocks/groups.

From the measuring mode call:

- Press the softkey EVAL-UATE.
- Enter the number of the first and last block to be included in the evaluation: 0 ... 9.
  Press the ENTER key to advance the cursor to the next entry box.

☞ According to the entry, the information for the 'number of blocks' and 'number of measurements' will change on the menu page.

- Press the softkey STAT. to open a menu page with the calculated statistical characteristics of the selected block.

  Press the softkey PAGE to view additional characteristics on the next menu page.

Dual Coating Measurement Application SIGMA (DUPLEX)

Dual coating measurement application: Use the softkey 1. or 2. to call the characteristic data for the respective coating.
1. displayed: Momentarily, the display for the characteristics for coating 2 (intermediate coating) appear,
2. displayed: Momentarily, the display for the characteristics for coating 1 (top coating, paint coating) appear.

☞ If **automatic block creation is enabled** the characteristic data will be displayed as shown in the table 'Evaluation Across Several Blocks/Groups (Final Result' on Page 11-16.
If **automatic block creation is disabled** the characteristic data will be displayed as shown in the table 'Evaluation Across Several Single Readings (Block Result)' on Page 7-16. In this case, the selected (manually created) blocks will be treated as one single block for the evaluation.

Printing

☞ Depending on the settings in menu function 10, only the single readings, single readings and block results, or the block results alone will be printed (PRINT).

☞ Whether the printout looks like the Fischer default print form or a user-defined print form depends on the "Print Form Selection ", (menu function 1).

For a description of the statistical terms as well as the formula signs used see the Glossary, Chapter B.

Evaluation from Block x to Block y
(continued)

EVAL-UATE

2. Evaluation Across a Number of Blocks/Groups With the Same Feature

Call from Measuring Mode:

- Press the softkey EVAL-UATE.
- Enter the numbers of the first and last block to be included in the evaluation: 0 ... 9.
  Press the ENTER key to advance the cursor to the next entry box or to the “Feature” list.
- From the “Feature” list select the desired feature (description):
  ▼2 or ▲8 and CON-FIRM.

☞ Depending on the entry, the information about the ‘number of blocks ’ and ‘number of measurements’ will change on the menu page.

- Press the softkey STAT. to open a menu page with the calculated statistical characteristics of the selected block.

  Press the softkey PAGE to view additional characteristic data on the next menu page.

Dual Coating Measurement Application SIGMA (DUPLEX)

  Dual Coating Measurement Application: Press the softkey 1. or 2. to call the characteristic data for the respective coating.
  1. displayed: momentarily, the display for the characteristics for coating 2 (intermediate coating) appears,
  2. displayed: momentarily, the display for the characteristics for coating 1 (top coating, paint coating) appears.

☞ If **automatic block creation is enabled** the characteristic data will be displayed as shown in the table ‘Evaluation Across Several Blocks/Groups (Final Result’ on Page 11-16.
If **automatic block creation is disabled** the characteristic data will be displayed as shown in the table ‘Evaluation Across Several Single Readings (Block Result)’ on Page 7-16. In this case, the selected (manually created) blocks will be treated as one single block for the evaluation.

Printing

☞ Depending on the settings in menu function 10, only the single readings, single readings and block results, or the block results alone will be printed (PRINT).

☞ Whether the printout looks like the Fischer default print form or a user-defined print form depends on the “Print Form Selection”, (menu function 1).

📄 For a description of the statistical terms as well as the formula signs used see the Glossary, Chapter B.

11.3.2 Evaluation of One Block

Evaluation of One Block

BLOCK RES.

After a block ends (automatically or manually), an evaluation across the complete block is performed automatically. The block result of the last block, but also of an earlier set up block can be viewed in the block result menu (not the evaluation menu).

☝ **Warning:** If automatic block creation is disabled, an **end of a block** is set by pressing the softkey BLOCK RES.. If an end of the block is not desired, select the last block number and press the softkey BLOCK CONT. (**not** CON- TINUE), to exit the block result menu without setting a block end!

☞ This function is not available in SPC chart display.

Prerequisite:

- The application, where an evaluation is to take place, must be active and in measurement mode.
- The measurement data presentation mode for the active application must be either in numeric display or in specification limit display.

Call from measurement screen only:

Dual Coating Measurement Application SIGMA (DUPLEX)

- Press the softkey BLOCK RES. to open a menu page with the block result for the last block.

  Dual Coating Measurement Application: The block results for all coatings will be displayed on the menu page.

View the block result of an earlier block:

- Press the softkey BLOCK - or BLOCK + in the block result menu several times until the desired block number appears in the uppermost display line. The respective characteristic data for this block are displayed immediately underneath.

☞ Upon return to the measuring mode, the measurement (measurement data) of the block selected last in the block result menu will be displayed. With the next measurement, the measurement series is continued automatically after the last measurement (block).

☝ The last currently open block is concluded automatically if an earlier block is selected from the block result menu, and measurements are no longer possible. If an end of a block is not desired, select the last block number and press the softkey BLOCK CONT. (**not** CON- TINUE) to exit the block result menu without ending the block!

Evaluation of One Block
(continued)

BLOCK RES.

Printing Block Result

General Notes

☞ To print the block result for the selected block use the softkey **PRINT**.

☞ The printout of the block result with **PRINT** is independent of the settings in menu function 10.

☞ No changes to the settings can be made in the block result menu. This menu is for information purposes only.

📄 For a description of the statistical terms as well as the formula signs used see the Glossary, Chapter B.

11.4 Literature

Standards

DIN 1319: Basic concepts of measurement; concepts for uncertainty of measurement and for evaluation of measuring instruments

DIN EN ISO 2064: Metallic and other non-organic coatings - Definitions and conventions concerning the measurement of thickness

DIN EN ISO 2178: Non-magnetic coatings on magnetic substrates - Measurement of coating thickness - Magnetic method

DIN EN ISO 2360: Non-conductive coatings on non-magnetic substrates - Measurement of coating thickness - Eddy current method

ISO 3534: Statistics; Vocabulary and Symbols

DIN EN ISO 3882: Metallic and other non-organic coatings - Review of methods of measurement of thickness

ASTM B 244: Standard method for measurement of thickness of anodic in aluminum and of other non-conductive coatings on non-magnetic basis metals with eddy-current instruments

ASTM MNL-7: Manual on Presentation of Data and Control Chart Analysis, 6th Edition (ISBN 0-8031-1289-0)

Statistics and Coating Thickness Measurements

DataMyte Corporation: DataMyte Handbook - A practical guide to computerized data collection for Statistical Process Control

Duncan, Acheson J.: Quality Control and Industrial Statistics; Homewood, Illinois: Richard D. Irwin, Inc.

Ford Q-101: Qualitätssystem-Richtlinie

Helmut Fischer GmbH + Co: Reports

12 Data Transfer

12.1 RS232 Data Transfer

Transfer Measurement Data Via RS232 from the MMS® to an Exteranl Instrument (e. g., PC)

- Press softkeys **EVAL-UATE** (call evaluation menu) and **PAGE** (switch to the second menu page).
- Send measurements: **RS-232**

Connection see Chapter 3, page 3-3.

Default settings and setting the data format see Chapter 6, page 6-90.

Transfer Formats

Data Transfer (General)

- All input and output data are transferred as ASCII strings.
- Each string or command must end with a CR, LF or CRLF.
- Data received by the MMS® may not be more than 20 characters long.

Measurement Data Output from the MMS via RS232

- Single reading, block mean values without separator: [-]xxxx.xxx CRLF
- Single reading, block mean values with separator: [-]xxxx.xxx CRLF
  * CRLF
- Block mean value + Date:
  [-]xxx.xx DD.MM.YYYY hh.mm.ss CRLF
- Block mean value + Date + Feature:
  [-]xxx.xx dd.mm.yyyy hh.mm.ss xxxxx CRLF

DD = Day; MM = Month; YYYY = Year; hh = Hours; mm = Minutes; ss = Seconds

Commands

Commands

Commands to the MMS®	Function
G0 (G Zero)	External Start, triggers measurement
ES	External Start, triggers measurement
PT0 - PT5	Output setting for the RS232 port 0 = no output to the RS232 port 1 = Send single reading without separator 2 = Send single reading with separator 3 = Send the block mean value only 4 = Send the block mean value with date 5 = Send the block mean value with date and feature
SP	Output of the probe data to the RS232 port (no CRLF)
EN	Measurement trigger without saving the measurements
z XX	Sends current countrate, this value is not received by the MMS® (does not apply for BETA)
y XN	Sends current normalized countrate, this value is not received by the MMS® (does not apply for BETA)
NA	Sends current name of application (10 characters + CRLF)
VV	Sends current version of Software
GG	Sends block size (N_i) of the active application
IE	Sends numbers of single readings which are combined to a "standardized measurement value" (i-individual values).
PG0- PG7	Setting up the character for the group separator: 0: "GS" (ASCII 29) 1: "," (ASCII 44) 2: "*" (ASCII 42) 3: ";" (ASCII 59) 4: "\" (ASCII 92) 5: "/" (ASCII 47) 6: "#" (ASCII 35) 7: ":" (ASCII 58)
PE	Sends current group separator character

Key Codes for Remote Control

Key Codes

Command to the MMS®	Function
ESC 0	MMS key 0
ESC 1	MMS key 1
ESC 2	MMS key 2
ESC 3	MMS key 3
ESC 4	MMS key 4
ESC 5	MMS key 5
ESC 6	MMS key 6
ESC 7	MMS key 7
ESC 8	MMS key 8
ESC 9	MMS key 9
ESC "	MMS key .
ESC -	MMS key +/-
ESC M	MMS key MEAS
ESC B	MMS key ZERO
ESC C	MMS key CAL
ESC N	MMS key MENU
ESC H	MMS key HELP
ESC O	MMS key OFF
ESC R	Softkey 1 (top)
ESC S	Softkey 2
ESC T	Softkey 3
ESC U	Softkey 4
ESC V	Softkey 5 (bottom)
ESC A	MMS key APPL
ESC D	MMS key DEL
ESC E	MMS key ENTER

ESC = ASCII 27

12.1.1 Data transfer with the continuous mode enabled

In the continuous mode (menu function 9), the data is transferred online. Position the probe to start the transfer; disable the continuous mode to end the transfer.

Maximum transfer rate 5 readings per second when the parameter "Single readings without separator " is selected from menu function 13.

- Description of menu function 9 "Select Free Display Mode", Chapter 6, Page 6-58.
- Description of menu function 13 "Output to Serial Port", Chapter 6, Page 6-63.
- Description of menu function 18 "Disp. Mode / Meas. Trigger", Chapter 6, Page 6-70.

A Symbols are Used in the Operator Manual

☞	Note, indicates particular urgent notes
☝	Caution, indicates warnings of damage to the instrument or loss of data
●	Indicates an action that needs to be performed
•	Indicates listings
🗐	Reference, indicates a cross reference to other chapters and pages
ENTER	Refers to instrument keys (e. g. ENTER key)
CON-FIRM	Refers to instrument keys (softkeys), the functions activated by these keys are indicated on the right side of the display
1 ENTER	Refers to instrument keys, which have to be pressed immediately one after another
1, ENTER	Listing of possible keys, which may be used
`Parameter`	Indicates parameters or names of menu pages

B Glossary of Terms

χ^2-Test: 🗐 *Chi-Squared Test*

σ: Single reading of the electrical conductivity measurement. 🗐 *Single Reading*

$\sigma.$, $\bar{\sigma}$: Mean value of the electrical conductivity measurement. 🗐 *Mean Value*

$\sigma..$, $\overline{\sigma.}$, $\bar{\bar{\sigma}}$: Mean value of the subgroup mean values (electrical conductivity). 🗐 *Mean Value*

$\hat{\sigma}$: 🗐 *Estimated Standard Deviation*

Accuracy: Qualitative name for the amount of agreement between the measurement result and the true value. The accuracy is generally divided into 🗐 *Correctness* and 🗐 *Precision*.

Application: Measurement task of the user.

Application: The memory where the coefficients, the parameter settings, the function settings and the measurement data for a certain measurement application of the user are stored is also called application.

Application Memory: Memory, where the characteristic of a particular application is stored.

Application Selection: Menu page(s) where all previously defined applications are listed with number and name. Use the key APPL to select an Application Selection.

ASTM MNL-7: American Society for Testing and Materials, American standard. 🗐 *Control Limits*

Autom. Evaluation Printout: Enter the number of blocks across which an evaluation is to be performed and printed automatically. This printout is in addition to the output method selected in menu function 10. Activation and entry in menu functions 0 and 1.

Automatic Block Creation: 🗐 *Automatic Block Result*

Automatic Block Result: Enter the number of measurement data after which a block result is to be determined. In statistical evaluations, block mean values are used instead of single readings (the evaluation is analogous to that of the SPC chart). This function can be carried out only if an application does not contain any measurement data. Otherwise this function cannot be activated.

Baud: Unit of the speed for transferring information. 1 baud corresponds to a transfer rate of one bit per second.

Baud Rate: Data transfer rate. Used mainly in connection with terminal programs for data transfer. Since data are transferred via serial port, the transfer rate is calculated in bits per second.

Base Standard: Uncoated reference material (bare product) corresponding to the material and geometric properties of the finished product.

Batch Result: 🗐 *Block Result*

Bell Curve: 🗐 *Normal Distribution*

BETASCOPE®: Measuring type, indicates the coating thickness measurement according to the backscatter test method. Measurement of plastic, thin oil and metal coatings.

Bi-directional Data Transfer: Data can be transmitted and received by both participants (for example, from the instrument to the PC and from the PC to the instrument).

Bit (Binary Digit): Binary number. 1 bit is the smallest unit in the binary number system. The value of a bit is either 0 or 1. Being the smallest unit of information in a computer, a bit forms the basis of every computer system. 8 bits are combined to a byte, or serveral bytes to a word.

Block: Group of n single readings.
In connection with the SPC chart, all measurements are divided into subgroups (not blocks) with pre-defined subgroup sizes.

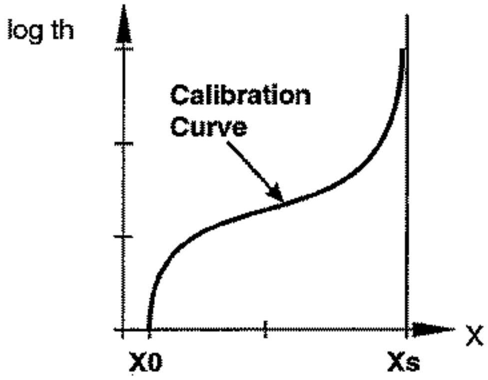
Block Mean Value: Mean value across the single readings belonging to one block.

Block Result: Statistical evaluation of a block. Mean value, standard deviation, coefficient of variation, range, minimum, maximum, number of single readings per block, etc..

Block Size: Number of single readings combined to form one block.

Calibration: Adjustment of the instrument to adapt the probe characteristic using calibration standards.

Calibration Curve (Characteristic): Quantitative relationship between the probe signal an a function of the coating thickness as defined by calibration standards. The coating thickness th can be displayed as a function of the probe signal (countrate X). A coating thickness of Zero produces the signal X_0 and the saturation thickness produces the signal X_S.



The thickness th (entered logarithmically as log th) is displayed in dependence of the countrate X as calibration curve.

X = X0 → uncoated measuring object
X = Xs → measuring object with at least saturation thickness

The mid portion of the calibration curve approches a straight line. This is the range wizh the smallest relative measurement error.

Calibration Foils: Foils with a known thickness used as calibration standards.When calibrating, the coating is simulated by the foil, which os placed on the uncoated measuring object.

Calibration Standards: A reference part with known coating thickness in the range of the coated parts to be measured and which corresponds to the substrate and coating material of the parts to be measured. In many cases this reference part will be identical to the parts to be measured.

Capability Factors: The process capability is evaluated by the factors Cp and Cpk. For more detailed information see, for example, Ford Guidline Q101.
The capability factor Cp is a measure for the deviation of a process and its ability to continuously produce parts according to specifications.
The capability factor Cpk takes the position of the mean value in relation to set limits into account.

$$Cp = \frac{USL - LSL}{6 \cdot \hat{\sigma}} \quad and \quad Cpk = Min\left\{\frac{USL - x..}{3 \cdot \hat{\sigma}} ; \frac{x.. - LSL}{3 \cdot \hat{\sigma}}\right\}$$

USL: Upper specification limit that has been defined as limit for the process control chart

LSL: Lower specification limit that has been defined as limit for the process control chart

$\hat{\sigma}$: Estimated value for the theoretical standard deviation $\hat{\sigma} = \sqrt{\frac{1}{n_{Gr}} \sum_{i=1}^{nGr} s_i^2}$

x..: Average of all subgroup mean values

n_{Gr}: Number of subgroups

Carriage Return (CR): CR is a character of the ASCII character set and has the following function: when data or commands are entered, the line one currently working on will be closed by pressing the CR key (Enter or Return key on the keyboard); the information entered will be processed accordingly. The cursor is again placed at the beginning of the kine. CR is usually used together with the LF (▤ *Line Feed*) character to start the next line at the beginning.

Chi-Squared Test (χ^2 test): Statistical mathematical test method to determine the normal distribution of the measurements (for more than 30 measurements).

Class: Range between a lower and an upper class boundary (e.g., coating thickness range). The measurement data of a measurement series can be sorted according to classes of equal width which cover the entire range of the measurement series. The number of measurements per class plotted for each class is called a histogram.

Closed Block: Group of n single readings with statistical evaluation.

Coefficient of Variation: The relative standard deviation as a percentage of the mean.

$$C.O.V. = \frac{s}{\bar{x}} 100\,[\%]$$

s: Standard deviation

$\bar{x}$: Mean value ≡ th., $\overline{th}$, σ., $\bar{\sigma}$, Fe., $\overline{Fe}$ for the coating thickness, electrical conductivity and ferrite content

For many coating processes, C.O.V. (%) is a characteristic process constant. A change in a parameter during the coating process can alter C.O.V. (%) significantly; thus, a sudden change of C.O.V. (%) indicates a change in the process conditions.

Comparability: ▤ *Comparative Precision*

Comparative Precision: Qualitative name for amount of agreement between the different measurement results obtained under comparable conditions. Comparable conditions means: Measurements on the same test specimen under defined test conditions, e. g. by different operators or with different instruments or at different locations. The comparative precision is the basic for calculation the confidence range of the expectation value. ▤ *Accuracy*

Confidence Borders: An area of the probability chart where the sum curve can be found. With a 95 % confidence (the confidence level) the true lower portion of the respective parameter value (e. g., Thickness) can be found within these borders. For normal distribution, the confidence borders p_{top} and p_{bottom} are calculated as follows:

$$p_{bottom} = \frac{x - x.}{\hat{\sigma}} - 1.96\sqrt{\frac{1}{n} + \frac{\left(\frac{x - x.}{\hat{\sigma}}\right)^2}{2n-2}} \quad ; \quad p_{top} = \frac{x - x.}{\hat{\sigma}} + 1.96\sqrt{\frac{1}{n} + \frac{\left(\frac{x - x.}{\hat{\sigma}}\right)^2}{2n-2}}$$

and for measurements that do not have normal distribution, the confidence borders are entered into the probability chart as a polygon and are calculated as follows:

$$p_{bottom}(i) = y_p(i) - 1.96\sqrt{\frac{1}{n} + \frac{(y_p(i))^2}{2n-2}} \quad ; \quad p_{top}(i) = y_p(i) + 1.96\sqrt{\frac{1}{n} + \frac{(y_p(i))^2}{2n-2}}$$

p_{bottom}:	Lower confidence border	n:	Number of single readings
p_{top}:	Upper confidence border	$\hat{\sigma}$:	Estimate for standard deviation of the base total
x:	Measurement (e. g., thickness)	$y_p(i)$:	y-values of the polygon (sum curve when the measurements do not have normal distribution) i = 1 to n - 1
x..:	Mean value of all measurements		

Control Limits: Limit values used for process control. If measurements above or below these limits are encountered, the process should be controlled in a manner that keeps the reject portion to a minimum. A parameter for the measurement mode 'SPC Control Chart'. The upper control limit (UCL) and the lower control limit (LCL) are calculated by the MMS® software either according the American Standard ASTM MNL-7 (default setting) or according to the formula of the Deutsche Gesellschaft für Qualität e. V. (German Society for Quality).

Calculation of the control limits according to ASTM MNL-7:

Control limits for the $\overline{x}$ chart:

$$UCL = x.. + \frac{3 \cdot \hat{\sigma}}{\sqrt{n_i}} \quad ; \quad LCL = x.. - \frac{3 \cdot \hat{\sigma}}{\sqrt{n_i}}$$

Upper Control limit for s chart (UCL (s)):

$$UCL(s) = \left[1 + \frac{3}{c_4} \cdot \sqrt{1 - c_4}\right] \cdot \hat{\sigma} \cdot c_4$$

Upper Control limit for R chart (UCL (R)):

$$UCL(R) = \left(1 + 3 \cdot \gamma_{n_i}\right) \cdot \overline{R} \qquad \text{with } \overline{R} = \hat{\sigma} \cdot d_2$$

When entering LSL, USL and Cp:

$$x.. = \frac{USL + LSL}{2} \quad \text{and} \quad \hat{\sigma} = \frac{USL - LSL}{6 \cdot Cp}$$

With a pre-run: $x.. = \frac{1}{n_{Gr}} \sum_{i=1}^{n_{Gr}} x._i$ and $\hat{\sigma} = \sqrt{\frac{1}{n_{Gr}} \sum_{i=1}^{n_{Gr}} s._i^2}$

UCL:	Upper control limit
LCL:	Lower control limit
USL:	Upper specification limit
LSL:	Lower specification limit
x..:	Mean value of the subgroup mean values displayed in the process control chart as $\overline{\overline{th}}$ for example (thickness measurement).
$\hat{\sigma}$:	Estimated value for the theoretical standard deviation σ (For more information see Ford Guidelines Q101)
s.	Mean standard deviation of all subgroup standard deviations
n_i:	Subgroup size
n_{Gr}:	Number of subgroups
$\overline{R}$:	Mean range of all subgroup ranges
Cp:	Capability factor, description see page B-2
c_4, γ, d_2:	Control chart factors. Factors dependent on the random sample size can be obtained from published tables

Calculation of the control limits according to, e. g., the formula of the Deutsche Gesellschaft für Qualität e. V. (German Society for Quality)

Control limits for the $\overline{x}$ chart:

$$UCL = x.. + \frac{2.576 \cdot \hat{\sigma}}{\sqrt{n_i}} \quad ; \quad LCL = x.. - \frac{2.576 \cdot \hat{\sigma}}{\sqrt{n_i}}$$

Upper control limit for the s chart (UCL(s)):

$$UCL(s) = B_{eo'} \cdot \hat{\sigma}$$

Upper control limit for R chart (UCL(R)):

$$UCL(R) = D_{eo} \cdot \overline{R}$$

Beo', Deo:	Limit factors, factors that depend on the random sampling size, taken from "Tabelle C25" from "Formeln und Tabellen der angewandten mathematischen Statistik" von Graf, Henning, Stange und Wilrich (Formulars and Tables of Applied Mathematical Statistics" by Graf, Henning, Stange and Willrich)
x.., n_i, $\overline{R}$, $\hat{\sigma}$:	see Calculation of control limits according to ASTM MNL-7

Corrective Calibration (one-point or two-point calibration): Adjustment of the instrument using an uncoated measuring object and one or two calibration standards. The corrective calibration includes calibration and adjustment.
During corrective calibration the calibration curve is adjusted to the individual measurement application, the current application is calibrated for. The coefficients of the master calibration curve, which are stored in the EEPROM of the probe connector, remain unchanged.

Correctness: Agreement between the true value and the mean value of the measurement results generally obtained under normal conditions. 🗐 *Accuracy*
The true value is considered a value known based on mathematical theoretical approaches. Because such values are very rarely available, a value traced to national or international standards is generally assumed as "correct". This correct value is often calles a true value.

Correct value: 🗐 *Correctness*

Countrate X: This is the probe signal displayed as the number of electrical impulses. X corresponds directly to the attribute to be measured, that is, the coating thickness, the electrical conductivity, or the ferrite content. The X value will range between the two extremes X_0 and X_S. X_0 corresponds to a measurement of 0, e.g., th = 0. X_S corresponds to maximum value that can be measured with the probe in use, e.g., coating thickness th = saturation coating thickness, electrical conductivity $\sigma = 100$ % IACS. In general, displaying the countrate X is used to determine if there is a viable measurement signal for a particular measurement application. From the result, it can be determined if another test method might be better suited.

C.O.V. (Coefficient of Variation): 🗐 *Coefficient of Variation*

Cp: 🗐 *Capability Factor*

Cpk: 🗐 *Capability Factor*

CR (Carriage Return): 🗐 *Carriage Return*

Cr, CR: Short form for the material Chrome.

Cu, CU: Short form for the material Copper.

Cumulative Frequency Distribution: A form of display of the measurement data distribution, such that the number of measurements smaller or equal to a particular measurement is calculated and displayed in percent.

Cumulative Frequency Dstribution Chart: 🗐 *Normal Probability Chart*

Curvature: Excess and 🗐 *Kurtosis* are measure for curvature (e. g. how pointed or how wide) of a distribution compared to a normal distribution.

CU-SCOPE: Measuring type, indicates the coating thickness measurement specally for measurement of copper thickness on PC-boards according to the eddy current test method. Measurement of copper thickness on PC-boards, even under solder resist, and the copper plating thickness in PC-boards through holes.

Data Transfer Rate: 🗐 *Baud Rate*

Deviation of the Subgroup Mean Values: Calculated by the instrument only when the measurements were performed with fixed block size (subgroup size) and the deviations of the block mean values (subgroup mean values) cannot be attributed to the deviations within the subgroups, as determined by analysis of variance methods (A.O.V.; $F_{beo} > F_{tab}$). It describes the deviations of the block mean values (subgroup mean values) in relation to the deviations of the single measurements within the blocks (subgroups). With a suitable measurement strategy, s_a is a measure of the product deviation.

$$s_a = \hat{\sigma}\sqrt{\frac{F_{boe}-1}{n_i}}$$

$\hat{\sigma}$: Estimated standard deviation σ of the base total

F_{beo}: Quantile of F-Distribution (observ): $F_{beo} = \frac{s_{II}}{\hat{\sigma}^2}$ with $s_{II} = \sqrt{n_i} \cdot \sqrt{\frac{1}{n_{Gr}-1}\sum_{Gr=1}^{n_{Gr}}(X. - X..)^2}$

X. : Subgroup mean value (block mean value)
X..: Mean value (average) of block/subgroup mean values
n_{Gr}: Number of blocks/subgroups

n_i: Subgroup size (block size)

If, for instance, the same number of measurements is performed on several measuring objects and the measurements on each object are combined into a block (subgroup), s. ($\equiv s_{II}$) is a measure for the instrument deviation and s_a is a product deviation with the instrument deviation eliminated.

Difference Measurement: Measuring mode to determine the coating thickness of up to 4 layers. See Chapter 5, page 5-21.

DIN: Deutsches Institut für Normung e. V. (German Institute for Standardization). For the MMS®, the description of the calculation of the control limits according to a formula customary in Germany. *Calculation of the control limits according to, e. g., the formula of the Deutsche Gesellschaft für Qualität e. V. (German Society for Quality)*

Dual Probe: Dual probes can be used to measure coating thickness according to the magnetic induction test method and eddy current test method. When placing the probe on measuring object, the test method siuited for the coating substrate-combination will be automatically selected.

DUALSCOPE®: Measuring type, indicates the coating thickness measurement with one probe according to the magnetic induction and the eddy current test methods. The probe works with both test methods. Measurement of non-conductive and NF coatings on steel or iron as well as measurement of non-conductive coatings on NF substrates.

EEPROM (Electrically Erasable Programmable Read Only Memory): Advanced EPROM. The content of the memory can be erased electrically.

End of Block: Mark after n single readings. An end of block marker can be set automatically (function) or manually using a softkey.
The audible indication of the end of a block is a long acoustic signal.

The visual indication is a marker in numeric display: after the last measurement of a block. The visual indication in specification limit and SPC control chart display is a vertical line after n measurement points.

Error Cone: *Confidence Borders*

Estimated Standard Deviation: Estimate $\hat{\sigma}$ for the standard deviation σ of the base total:

$$\hat{\sigma} = \frac{\overline{R}}{d_2}$$

$\overline{R}$: Mean range across all subgroup ranges

d_2: SPC chart factor. The factor, that depends on the random sample size, can be obtained from published tables.

or for specified limits as available data:

$$\hat{\sigma} = \frac{USL - LSL}{6 \cdot Cp}$$

USL: Upper specification limit
LSL: Lower specification limit
Cp: Capability factor (default setting 1.33), 📄 *Capability Factors*

Evaluation: Calculation of statistical parameters, such as mean value, standard deviation, etc., as well as the graphical display of the measurements, e. g., in a SPC chart or in a sum frequency chart.

Evaluation Menu: Selection menu for the evaluation and display of the measurement data: SPC Control Chart evaluation/display, Histogram display, Probability chart display, list with statistically calculated values (mean value, standard deviation, etc.), Data Output via RS232 or to printer. Use softkey EVAL-UATE to select the menu.

Excess: 📄 *Kurtosis*

External Start: Triggering the capture of measurements by pressing ENTER, by sending the command G0 from the connected PC or by using a connected pedal switch.

Fe, FE: Short form for magnetizable material of steel or iron.

Fe, fe: Single reading of the ferrite content measurement. 📄 *Single Reading*

fe., $\overline{fe}$: Mean value of the ferrite content measurement. 📄 *Mean Value*

fe.., $\overline{\overline{fe}}$: Mean value of the subgroup mean values (ferrite content measurement). 📄 *Mean Value*

Feature: Description of a block/subgroup. The feature is an additional user-defined information to define blocks/subgroups. This block description/subgroup description (max. 5 characters) may be an order number, a batch name, etc.. A feature can be assigned to a block/subgroup during a measurement or at a later time. An evaluation can be performed according to features - evaluation of all blocks according to features. 📄 Chapter 6, pages 6-21 and 6-54

Features: Properties of a product. Measurable properties of a product, such as coating thickness, are the variable features. Attributive features are the properties of a product that usully cannot be measured, such as color nuances.

Feature Value: 📄 *u-Scale*

FERITSCOPE®: Measuring type, indicates the measurement of ferrite contents according to the magnetic induction test method. Measuring of the ferrite content in austenitic and duplex stainless steel.

Final Result: Evaluation of all measurements stored in the current application. The results of this evaluation (e. g. mean value and standard deviation) will be displayed by pressing STAT. in the evaluation menu.

FISCHERSCOPE®: Measuring type, indicates measurements for applications receiving their data via the RS232 interface (RS232 Applications), e.g., data from a measuring gauge.

Frequency Distribution: 📄 *Histogram*

Gaussian Distribution: 📄 *Normal Distribution*

Gaussian Normal Distribution: 📄 *Normal Distribution*

Gaussian Probability Paper: 📄 *Normal Probability Chart*

Grubbs Test: Method for 📄 *Outlier Rejection*. A method by Grubbs used to test whether the highest or the lowest single reading should be considered an outlier.

Highest Value: 📄 *Maximum*

Histogram (Frequency Distribution): Frequency distribution, graphical display of all single readings of an application according to classes (e. g., coating thickness ranges) having the same width. Among other criteria, the meaningfulness of the statistical results depends on the shape of this distribution curve. 📄 *Curvature*

Interface: Transfer and connecting points between components, circuits and programs. Interfaces are used for data exchange.
With serial interfaces, the data are transferred in individual bits (i. e., one bit after another), with parallel interfaces, several bits are transferred simultaneously.

ISOSCOPE®: Measuring type, indicates the coating thickness measurement according to the eddy current test method. Measurement of non-conductive coatings on NF substrates.

Kolmogoroff-Smirnoff Test: Statistical mathematical test method to determine the normal distribution of the measurements (for 5 to 30 measurements).

Kurtosis: A measure about how pointed (excess) or flat (kurtosis) a distribution is in comparison to the normal distribution. A positive kurtosis indicates a relatively narrow and pointed distribution. A negative kurtosis indicates a relatively flat and broad distribution. At normal distribution, the kurtosis is Zero.

LCL (Lower Control Limit): 📄 *Control Limits*

LF (Line Feed): 📄 *Line Feed*

Line Feed (LF): Advanced the printer paper by one line. It is usually used together with the CR (📄 Carriage Return) charachter to start the next line at the beginning.

Lowest Value: 📄 *Minimum*

LSL (Lower Specification Limit): 📄 *Specification Limits*

Master Calibration: Adjustment of the instrument using an uncoated measuring object and calibration standards. During a master calibration, the master calibration curve is determined. The master calibration includes calibration and adjustment.

Master Calibration Curve (Probe Characteristics): Characteristics of the measuring system. The master calibration curve is determined during master calibration on smooth, flat substrate material. It is the basis for determination of the measurement values, since it represents the relationship between the coating thickness and the probe signal. The coefficients of the master calibration curve are stored in the EEPROM of the probe connector.

Maximum: Highest measured value of a test series.

Mean Value: Arithmetic mean value $\overline{x}$ (e.g. thickness measurement $\overline{th}$) of a measurement series consisting of n single readings th_i, according to the equation

$$\overline{x} = \frac{x_1 + x_2 + x_3 + \ldots + x_n}{n} = \frac{1}{n} \cdot \sum_{i=1}^{n} x_i$$

$\overline{x}$ = x.: Mean value = th., $\overline{th}$, σ., $\overline{\sigma}$, Fe., $\overline{Fe}$ for the coating thickness, electrical conductivity and ferrite content

xi: Single readings

n: Number of single readings

Mean Value: Mean value (average) of the block/subgroup mean values of the evaluated blocks/subgroups. Analogous to the arithmetic mean value, here the block/subgroup mean values are added together and divided by the number of evaluated blocks/subgroups n_{Gr}:

$$x_{..} = \frac{1}{n_{Gr}} \sum_{i=1}^{n_{Gr}} x_{.i}$$

x..: Mean value of the blocks/subgroups

x.i: Block/subgroup mean values

n_{Gr}: Number of blocks/subgroups

Measurement: Numeric reading of an instrument, expressed in the unit of measurement. The measurement can be obtained as the result of a single measurement or as arithmetic mean of several single measurements (parameter "i individual value" activated).

Measurement Accuracy: ▤ *Accuracy*

Measurement Application: Properties of the test specimen with regard to material, coatings, geometric dimensions, permeability, el. conductivity etc.. The test method, the measurement display mode, the probe and the type of instrument are all determined by the measurement application.

Measurement Block: ▤ *Block*

Measurement Data: ▤ *Measurement*

Measurement Data Presentation: Refers to the type of display presentation and evaluation presentation of measurement data. 4 types of presentations are available in the MMS®: Numeric Display, Specification Limit Display, SPC Control Chart, and Difference Measurement.

Measurement Error: Difference between the actual and measured value of a parameter. For measuring instruments, there is a distinction between random (unpredictable) and systematic (correctable) measurements errors. Random errors determine the degree repeat ▤ *Precicion*. Systematic errors (bias) affect the ▤ *Correctness* comparative precicion.

Measurement Range: ▤ *Measuring Range*

Measurement Series: A series of single measurement readings between two block or final results.

Measurement Task: Characteristics of the specimen with regard to material, coatings, geometric dimensions, permeability, el. conductivity, etc. The test method, measuring mode, probe and instrument are determined by the measurement task.

Measurement Uncertainty: Every instrument is subject to random measurement errors. ▤ *Accuracy*. At a certain probability (the confidence level), the presumed "true" value (μ) of the measurement parameter lies within an interval around the measured mean value (x.) of a measurement series. This interval is also called confidence interval. The boundaries of this interval define a certain range which determines the measurement uncertainty u of the mean value μ: $x. - u \le \mu \le x. + u$

For a base total at normal distribution and pre-set confidence level (1-α), the measurement uncertainty is calculated according to the following formula:

$$u = \frac{t \cdot s}{\sqrt{n}}$$

t: Student distribution factor (can be obtained from any popular publication of mathematical statistics tables). At a confidence level of 95 % and n > 200, for instance, the student distribution factor t = 1.96.

n: Number of measurements performed

s: Standard deviation

By entering the coefficient of variation (C.O.V.) in place of the standard deviation s one gets the relative measurement uncertainty u_{rel} in %.

$$u_{rel} = \frac{t \cdot C.O.V.}{\sqrt{n}} [\%]$$

Measuring: Measuring is comparing.
The probe signal generated at the measuring position is compared to the probe signal of the calibration standard. Using the calibration curve, the instrument converts the probe signal to the measurement result. The result is reported in the unit of the measurement of the calibration standard.

Measuring Area: 🗐 *Test Point*

Measuring Method: 🗐 *Test Method*

Measuring Mode: The condition in which the instrument can capture and display measurement data. The display mode is determined by the measurement type setting of the instrument.

Measuring Object: Object on which the measurements are to be performed to determine the coating thickness for example.

Measuring position: 🗐 *Test Point*

Measuring probe: 🗐 *Probe*

Measuring Range: The range between two limits within which measurement is possible at a specified 🗐 *Correctness* and 🗐 *Precission*. In a narrower sense it refers to the range of the display of an analog instrument. The measuring range depends on the measurement method, the design of the probe and the measurement application.

Measuring Type: Refers to the test method, coating/substrate combination and the probe type. The measuring type are always shown in the display: PERMASCOPE®, ISOSCOPE®, DUALSCOPE®, BETA, SIGMA (...), NICKELSCOPE®, SIGMASCOPE®, FERITSCOPE®, FISCHERSCOPE®. The normalization and calibration procedures differ depending on the measuring type.

Measuring Unit: Unit used for the measurement data display. In coating thickness measurement, the common unit of measurement in the metric system is the μm (micrometer = 1/1000 mm), and in the US-system it is the mil (1/1000 inch ≈0.0254 mm = 25.4 μm).

Memory: Data storage element of a microprocessor-based measuring instrument. Information is saved in the memory. 🗐 *Application* and *Application Memory*

Menu Functions: Instrument functions to configure or edit an application. They can be retrieved from menu overview with MENU key and number of the menu function and ENTER key or, if the menu function number is known, directly from the measuring mode of the current application with menu function number and MENU key.

Menu Pages: Displays that can be retrieved with the softkey PAGE.

Method: 📄 T*est Method*

Minimum: Lowest measured value of a test series (block).

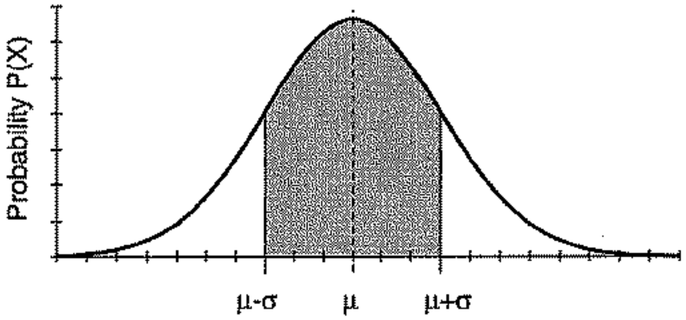
NC: Short form for electrically non-conductive and non-ferromagnetic materials.

NF: Short form for non-ferromagnetic = non-magnetizable, electrically conductive material.

Ni, NI: Short form for the material Nickel.

NICKELSCOPE®: Measuring type, indicates the coating thickness measurement according to the magnetic method. Measurement of plated nickel coatings on non-conductive or non-ferrous metal substrates. Does not cover Ni/Fe.

Normal Distribution (Gaussian Normal Distribution, Gaussian Distribution, Bell Curve):
Probability Distribution discovered by C. F. Gauß in 1794.
A parameter is considered to have normal distribution if 68.3 % of the observed values of X are within the deviation range σ around the mean value μ of the parameter X, i.e., for 68.3 % of the observed values, $\mu - \sigma \le X \le \mu + \sigma$. In the following figure, this interval is described by the gray area underneath the curve.



Probability distribution P(X) of a paramater X with normal distribution

The probability distribution P(X) is symmetrical around the value μ of the parameter X with normal distribution. With normal distribution, the 📄 *Skrewness* and 📄 *Kurtosis* are Zero.

However, the following facts are of great significance: If several random samples of equal size are taken from any base total (blocks/subgroups) and their mean values (block/subgroup mean values) are determined, then these mean values will always have normal distribution (central limit value rule).

The mean value of these random sample mean values is an estimate for the mean value μ of the base total.
Based on the normal distribution, the measurement uncertainty can be calculated using the standard deviation of the random sample mean values.

The probability chart shows if a parameter has normal distribution; a straight line indicates normal distribution.
In the FISCHERSCOPE® MMS®, the test whether the measurement data at hand have normal distribution, is carried out with the Kolmogoroff-Smirnoff test (up to 30 measurements) and the Chi-Squared test (30 and more measurements).

Normalization: Adjustment of the Coating thickness measuring instrument to a Zero and/or End value. It is important for applications where the substrate changes or when the test method exhibits instability (long-term drift).

Normalized Countrate: The absolute countrate values X (probe output) can range between X_0 and X_S. By applying equation 6_1 , the numeric value for X_N is always between 0 and 1. This is called the normalized countrate (normalized probe output signal).

$X_N = \frac{X - X_0}{X_S - X_0}$ Equation 6_1

X: Countrate measured on the coated specimen.

X_0: Countrate measured on the uncoated specimen.

X_S: Countrate measured on the specimen with the least saturation coating thickness

The attribute to be measured can be displayed over the normalized countrate as calibration curve. (Fig. below).

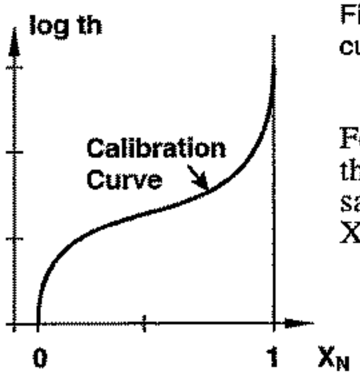


Fig. left: Example of a calibration curve for coating thickness

For coating thickness of Zero, the signal $X_N = 0$ and for the saturation thickness the signal $X_N = 1$.

The mid portion of the calibration curve approaches a straight line. This is the range with the smallest relative measurement error. In general, this range will be between $X_N = 0.35$ and 0.85. The normalized countrate is, therefore, ideally suited to determine if a measurement of an application is within this 'optimal' range. Standards for a master calibration must be within certain X_N ranges. This can be checked or determined easily by displaying X_N.

Normal Probability Chart (Gaussian Probability Paper): Graphic method to check for normal distribution of the measurements. A straight line in the normal probability chart indicates normal distribution.

Off-Line: Status of a peripheral device connected to the instrument (printer or PC) that does not allow it to receive data.

Offset: Correction factor that is to be deducted from the measurement.

On-Line: Ready condition of a peripheral device connected to the instrument (printer or PC) that does allow it to receive data.

Open Block: Group of single readings where the block has not yet been ended. Thus, they also have not yet been statistically evaluated.

Outlier Control: ☞ *Outlier Rejection*

Outliers: Measurements that are significantly smaller or greater than the rest of the measurements of a measurement series and that are, therefore, considered unexpected or unacceptable. With outlier rejection enabled, recognized outliers will be indicated by two short accoustic signals immediately after measurement accept and the simultaneous appearing of ↑ and ↓ in the display before the value.

Outlier Rejection: Monitoring and rejection of faulty production parts. A double beep signals audible that a measurement is outside a preset limit range. These outlier measurements are not taken into consideration for the statistical evaluation. The outliers are marked with a !. In the SPC Control Chart they are marked as deleted and do not appear as single readings.
The MMS® offers two different methods of outlier rejection:
automatic: This method identifies outlier measurements based on a statistical test (Grubbs test) at a statistical confidence level of P = 90 %.
Sigma known: If the standard deviation (Sigma of the measurement distribution) is known the Sigma value can be used to identify outlier measurements at a confidence level of P = 99 .9 %. A reasonably secure estimate of Sigma must be known and it should be based on a sufficiently large number of measurements. For this purpose a trial measurement series of no less than N = 100 measurements is recommended. Furthermore the assumption must be made that Sigma does not change significantly with each new measurement series. If this assumption can be justified then outlier measurements can be readily identified.

Parity: An error checking method, where the digits of a number must add up to an even or an odd number. During data transfer, the parity bits are added to the data bits of each character or byte to be transferred. In a word, this bit is set such that ones of the byte always result in an even or an odd number (corresponding to an even or odd parity). The type of paraity must be defined prior to the data transfer. By checking the parity, the receiver can determine if simple bit transfer errors occured.

PERMASCOPE®: Measuring type, indicates the coating thickness measurement according to the magnetic induction test method. Measurement of non-conductive and NF coatings on steel and iron.

PIN: Connectors for integrated circuits or for connecting plugs of computers and peripheral devices. Usually in a shape of a pin.

Port: 📖 *Interface*

Precision: Degree of agreement between the individual measrement results at precisely defined test conditions. Is comprised of comperative precision and repeatability precision. 📖 *Accuracy, Comparative Precision, Repeatability Precision.*

Pre-Run: Machine process performed under equal conditions as the actual high-volume production process. Using a pre-run, the process capability and the quality capability of a process can be evaluated. The quality capability informs about the suitability of the process to produce parts that meet the quality requirements. From the frequency distribution of the parameter values of the pre-run, assumptions are made about the distribution of the parameter values of the process (base total). The parameter values of the pre-run are also used to calculate (=estimate) the control limits for the process. The number of parameter values measured in the pre-run must be sufficient to allow for a relatively accurate calculation (estimate).
Example: 25 random samples, random sample size 5. For a 95% confidence level, the standard deviation σ of the base total is $0.88 \cdot \hat{\sigma} \leq \sigma \leq 1.16 \cdot \hat{\sigma}$.

This means that the estimate obtained from the pre-run as a significant uncertainty. It is, therefore, absolutely necessary to update these estimates over time.

☞ Estimates are indicated by the (^) character above the formula sign of the respective parameter.

Print Form: Printout where the measurements of the MMS® are printed in a format defined in the print form template.

Print Form Selection: Menu page to select the desired print form template for the printer output or data transfer via the RS232 port.

Print Form Template: A print form template can be designed on a PC with the print form software and then imported into the MMS®. The design of the print form template is defined in a print form template. Variables (for measuremnet data, standard deviation, date and other information) can be entered in the print form template as well as explanatory comments.

Probability Chart: 📖 *Normal Probability Chart*

Probability Paper: 📖 *Normal Probability Chart*

Probe: Transducer that delivers an electrical signal to the instrument based on a particular test method. This signal is proportional to the coating thickness and is converted to a corresponding coating thickness value in the instrument according to the probe characteristic.

Process Capability: Statistical Process Control (SPC) often uses random samples to control a production such that the production process is under statistical control. The capability factors that the specifications can be met. The process capability is evaluated with the factors Cp and Cpk. Process capability is a measure for long-term influences stemming from the so-called 6 Ms (mankind, machine, material, method, measuring instrument and milieu). To determine the process capability, a longer sequence of cyclical production steps needs to be employed (same product, same production line, same conditions, but different orders on different days). Machine capability is met when the process capability factor meet the following conditions: Cp ≥ 1.33 and Cpk ≥ 1.0. 📖 *Capability Factors*

Process Capability Index (Cp and Cpk): 📖 *Capability Factors*

Process Control: 📖 *Statistical Process Control*

Process Control Chart (SPC Chart): Quality control chart, control chart. Process control charts (mean value or standard deviation charts ($\bar{x}$-s charts), or range chart ($\bar{x}$-R charts)), provide a graphic comparison of a measured characteristic (of random sample) against computed control limits. They plot process variation over time and help to identify the causes of variations. The control limits are used as guidelines to determine when action should be taken in a process.

Quality Assurance: All measures taken by a producer to ensure a controlled production process within the established quality criteria. One aspect of it is quality control, specifically, coating thickness measurements where coating thickness limit specifications are involved.

Quality Control Chart: 📖 *Process Control Chart*

R: Range, 📖 *Range*

$\bar{R}$, R.: Mean range of all subgroup ranges is calculated as follows:

$$\bar{R} = \hat{\sigma} \cdot d_2$$

$\hat{\sigma}$: Estimated standard deviation σ of the base total

d2: SPC chart factor (for more information see Ford Guidline Q101). The factor that is dependent on the random sample size can be obtained from published Tables.

Random Measurement Error: 📖 *Measurement Error*

Random Sample: A small portion of a production batch taken in accordance with random statistical methods. The results of the random sample are extrapolated to the entire batch.

Random Sample Size: Number of parts combined to one random sample.

Range: Difference between the maximum and the minimum of a test series.

$R = x_{max} - x_{min}$ x_{max}: Largest reading ≡ th_{max}, σ_{max}, Fe_{max}

x_{min}: Smallest reading ≡ th_{min}, σ_{min}, Fe_{min}

Reference Measurement: Measurement on a reference part with a known coating thickness (electrical conductivity, or ferrite content) to check the normalization or calibration which was performed before.

Reference Part: Part with a known coating thickness (el. conductivity, or ferrite content) at a defined measuring position that can be used to check the calibration. Part with properties (geometry, material, permeability, etc.) that correspond to the parts of the current (control) measurement application, and with coating thickness (ferrite content, el. conductivity) close to the production parts which have be measured accurately. The reference parts may be from in-house production or may be from external sources. The coating thickness (el. conductivity, or ferrite content) of a reference part should been determined using a reliable and precisely calibrated instrument. (Important because of its use to monitor the measurement accuracy of the measuring equipment).
Reference parts are subject to wear and tear cause by the tractile measurement. The wear and tear is dependent on the coating material and on the probe which used for measurement. For this reason, reference samples if the wear and tear becomes significant.

Relative Standard Deviation: 📄 *Coefficient Of Variation*

Repeatability Precision: Repeated measurements under consistent conditions at the same measuring position have random deviations of the measurement data. The capability to achieve the same results with repeated measurements is called repeatability precision. The standard deviation of the measurement data obtained under repeat conditions is a measure for the repeatability precision. A large standard deviation (scatter) or measurement uncertainty of an instrument means poor repeatability precision.. The repeatability precision is dependent on the test method and the quality of the instrument, but often also on the properties of the specimen (for instance, surface roughness). Repeatability can be improved by generating the mean value of the measurement series (i single readings). 📄 *Accuracy*

Reproducibility: The ability of different operators of the same instrument to achieve practically the same measurement, when taking measurements at the same measuring position of the same specimen und equal measurement conditions. 📄 *Comparative Precision*

Report: User-defined compilation of codes relating to the measurement (e.g., mean value) and explanatory text, during an evaluation, the actual measurement data are entered into the print form. 📄 *Print Form*

Report Selection: 📄 *Print Form Selection*

Right Value: 📄 *Correctness*

RS232 Interface: A serial interface protocol standardized originally in the United States. Employed, for instance, to connect a PC to the FISCHERSCOPE® MMS®.

s: 📄 *Standard Deviation*

s_a: 🗐 *Deviation of the Subgroup Mean Values*

Saturation Countrate: Countrate measured on a coating with at least saturation thickness.

Saturation Standard: Coating thickness standard with the coating thickness exhibiting saturation thickness, corresponding also for el. conductivity (100 % IACS), or ferrite content (140 FN). The saturation standard may be also labeled with the ∞ character (e.g., Ni∞).

Saturation Thickness: The thickness of a coating where an additional increase in coating thickness no longer produces a change in the probe signal. It determines the end of the measurement range for a particular application or testing method. When measuring near saturation thickness, the measurement precision is usually lowest. A saturation thickness on a calibration standard may be also labeled with the symbol ∞.

SIGMA: Measuring type, indicates thickness measurement according to the eddy current test method. Corresponding to the coating material, the following distinction for the measuring types will be made: SIGMA (Ni/Fe), SIGMA (NF/Fe), SIGMA (NF/Iso), SIGMA (Cr/NF) and SIGMA (DUPLEX). The last listed measuring type constist additional to the eddy current the magnetic induction test method.

SIGMASCOPE®: Measuring type, indicates the electrical conductivity measurement according to the eddy current test method. Measurement of the electrical conductivity of non-ferrous metals.

Significant surface: Area on the surface of a measuring ogject containing the coating to be measured. All properties necessary for the use and appearance of the product must occur at this significant area.

Single Reading: Measurement result as displayed by the instrument after a single measurement at the measuring position.

Skewness: A measure for the asymmetry of a one-peak probability distribution around its mean value. A positive skewness indicates a distribution where the peaks stretch towards values greater than the mean value. A negative skewness indicates a distribution where the peaks stretch towards values smaller than the mean value. With a symmetrical distribution, the skewness is Zero (e.g., at normal distribution). 🗐 DIN 55350, Terms in Quality Assurance and Statistics

SPC: 🗐 *Process Control Chart*

SPC Chart: 🗐 *Process Control Chart*

Specification Limits: The upper specification limit (USL) is the maximum coating thickness (el. conductivity, or ferrite content) allowed on the measurement area of the specimen. The lower specification limit (LSL) is the minimum coating thickness (el. conductivity, or ferrite content) allowed on the measurement area of the specimen. Specification limits are usually set by engineering requirements to assure proper functioning or serviceability of the product.

Specifications: Requirements according to which production is defined within certain limits for features of the finished products, e.g., upper and lower specification limits for the coating thickness for an applied coating. Quality control monitors adherence to these requirements.

Specimen: Object (product) on which the measurements are to be performed.

Stability: As with every process, a measurement process has deviations as well. This may lead to systematic measurement errors (e. g., due to drift) regardless of the handling. One can ensure stability by examining the stability and through regular checks.

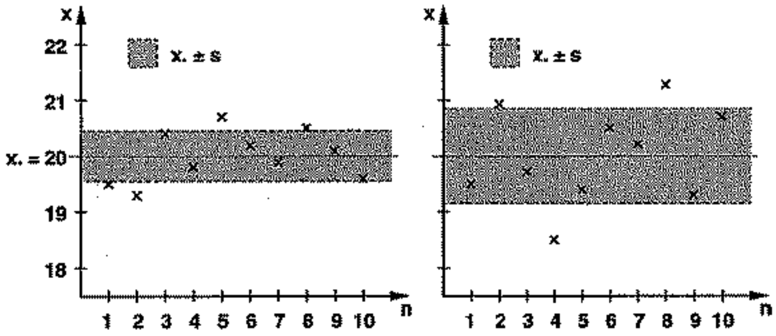
Standard Deviation: The standard deviation s is a measure of the deviations of single readings of a measurement series from their common mean value. It is equal to the mean square deviation of the single readings from the mean value and is calculated in the following manner:

$$s = \sqrt{\frac{1}{(n-1)} \sum_{i=1}^{n} (x. - x_i)^2}$$

x.: Mean value of all single readings ≡ $\overline{th}$, $\overline{\sigma}$, $\overline{Fe}$

x_i: Single readings ≡ th_i, σ_i, Fe_i

n: Number of single readings



The left figure shows two very different measurement series can have different standard deviations even with the same mean value.

Left figure: Measurement series with the same mean value x. and different standard deviations s.

Start Bit: With asynchronous serial data transfer, the start bit is transmitted prior to the data word to be transferred. With the logic One to logic Zero transition of the start bit, the receiver can be synchronized to the following data bits.

Statistical Evaluation: Calculations based on the measurement data using statistical mathematical methods.

Statistical Process Control (SPC): A statistical method to analyze and control the quality of a process. In high volume productions, only random samples are taken instead of 100 % inspection which would be too costly. The measurement results of the random samples are extrapolated for the entire production lot with mathematical-statistical methods, and then used to control the production process.

Statistical process control can only be used for quality control, if normal distribution of the measurements can be found.

This modern method of quality control ensures constant good quality, with a minimum level of rejection parts.

Statistics: The result of a measurement series, that is the compression of a large number of single readings into a few characteristic properties (e.g., mean value, standard deviation, maximum, minimum, range, coefficient of variation, etc.).

Subgroup: Random sample size, n measurements on one specimen or on n specimens.

Subgroup Mean Value: 🗐 *Mean value* across the single readings belonging to one subgroup.

Subgroup Size: The number of single measurements used to form a point on an SPC chart. 🗐 *Subgroup*

Subgroup Separator: Markers for the end of a block (end of a subgroup) that are transmitted to the PC along with the measurement data. Default marker is the ASCII character 029.

Substrate: Material of the part to be measured (specimen) without the coating to be measured.

Stop Bit: With asynchronous serial data transfer, the stop bit is added to the data word to be transferred. 1 to 2 bit logic Ones are used. After the stop bits, the transmitter remains at logic One until the start bit of the next character arrives.

Student Factor: The student factor (t) can be obtained from popular published tables and is specified as follows:

$f_{\left(1-\frac{\alpha}{2}\right);f}$ Example: At a confidence level of 95 % and n > 200 (and thus, degree of freedom f = 199 (because f = n - 1)), the student factor $t_{97,5;199} = 1.96$

Sum Frequency: The sum frequency is a portion of parts (in percent) where the thickness (for example) is smaller or equal to a particular measurement. In a sum frequency chart (probability chart) the sum frequency can be viewed as a function of the thickness for example. Example: one realizes, for example, that 9 % of the parts have a thickness smaller or equal to 70 µm. A straight line in in the sum frequency chart indicates a normal distribution of the measurements. Conclusions about the deviatiion range can be drawn from the gradient of the line.

Sum Frequency Chart: 🗐 *Normal Probability Chart*

Systematic Measurement Error (Bias): Generally speaking, a bias error which leads to a difference in the measured mean of a series of measurements and the true value of the quantity measured. More specifically, it is a measurement error that can be traced back to: (1) faulty calibration, (2) operator related errors (reproducibility), or (3) changes in test conditions (inhomogeneities of the substrate, aging, etc.). Bias errors tend to lean in one direction. With appropriate care, causes (1) and (2) can usually be avoided or corrected. Causes of the third kind can sometimes be eliminated by using an appropriate correction technique.

t: 🗐 *Student Factor*

Test Method: Procedure and process to obtain information from the specimen about its characteristics. The test method is based on scientific knowledge and is determined by the application. For coating thickness measurement, the test method must be capable to separate the coating to be measured from all other coatings and the substrate (🗐 DIN EN ISO 3882).

Test Point: A limited and clearly defined point within the reference surface of the measuring object where the coating thickness is to be determined.

Test Series: A series of single readings between two final results.

th: Single reading of the thickness measurement. 🗐 *Single Reading*

th., $\overline{\mathbf{th}}$: Mean value of the thickness measurement. 🗐 *Mean Value*

th.., $\overline{\overline{th}}$: Mean value of all subgroups (blocks) mean values (thickness measurement), 🗐 *Mean Value*

Tolerance Limits: 🗐 *Specification Limits*

Transfer Rate: 🗐 *Baud Rate*

True Value: 🗐 *Correctness*

u: Formula character for the measurement uncertainty. 🗐 *Measurement Uncertainty, Confidence Borders*

u-Scale: Scale on the right ordinate in the printout of the probability chart. Linear transformation of the measurements into standardized feature values u. The transformation serves comparison and analysis purposes. The standardized feature values are without dimension, their arithmetic mean is Zero and their Standard deviation $\sigma(u)$ is always 1.

UCL (Upper Control Limit): 🗐 *Control Limits*

UCL(R) (Upper Control Limits of the Range): 🗐 *Control Limits*

UCL (s) (Upper Control Limits of the Standard Deviation): 🗐 *Control Limits*

Unit: 🗐 *Measuring Unit*

USL (Upper Specification Limit): 🗐 *Specification Limits*

Variance: Mean squared deviation. The square root of the variance is called standard deviation.

X: 🗐 *Countrate*

$\overline{x}$, X. : Mean value of one block, one subgroup or application. 🗐 *Mean Value*

$\overline{\overline{x}}$, X.. : Mean value of all subgroup mean values (block mean values). 🗐 *Mean Value*

X_0: Zero point of the calibration curve. Countrate obtained when measurements are taken on the base standard or uncoated substrate.

X_N: 🗐 *Normalized Countrate*

X_S: Saturation value of the calibration curve. Countrate obtained when measurements are taken on the saturation standard or a saturation coating.

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