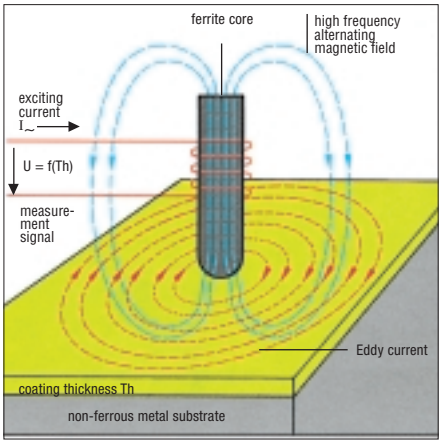
FISCHERSCOPE® MMS®

Universal Coating and Material Property Measurement System

Test Methods

Different applications require different test methods. The FISCHERSCOPE® MMS® can combine the most commonly used non-destructive test methods in one measuring system.
The measuring system operates according to the selected test method by using specific probes and corresponding test modules.

Eddy Current Method
(DIN EN ISO 2360, ASTM B244)

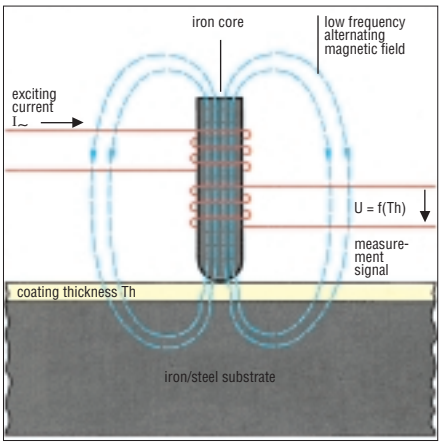


Test Method Basics
Contact test method. A high-frequency magnetic field induces Eddy currents in the conductive substrate material.
The magnitude of these Eddy currents depends on the distance between the probe coil and the substrate material.
The measurement signal is derived from the reflected impedance change in the probe coil as a function of the Eddy currents generated in the substrate material.

Modified Eddy Current Method

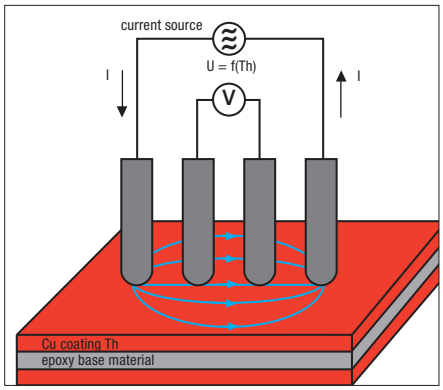
Test Method Basics
Contact test method. The magnitude and direction (phase angle) of the Eddy current probe signal is evaluated to measure the coating thickness. The test method is particularly useful to measure on rough surfaces. The method also can be used to measure the electrical conductivity of non-ferrous metals because it is inherently sensitive to changes in electrical conductivity.

Magnetic Induction Method
(DIN EN ISO 2178, ASTM B499)



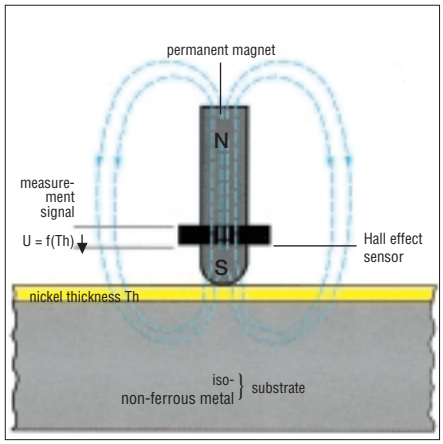
Test Method Basics
Contact test method. A low frequency AC excitation current generates a low frequency magnetic field. The magnetic flux density depends on the distance between the measurement probe and the ferromagnetic substrate. A probe output signal is generated by means of a pick-up coil. The instrument translates the measurement signal to coating thickness based on the probe characteristic and a suitable mathematical conversion model.

Electrical Resistance Method



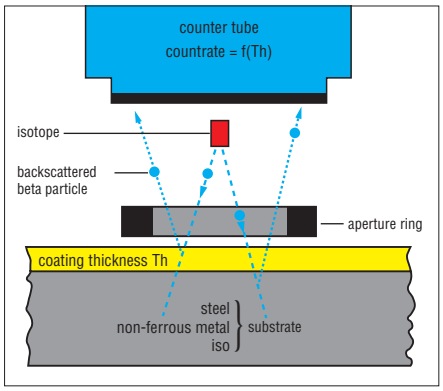
Test Method Basics
Contact test method. The two outer pins provide a current flow. The Cu coating between the two inner pins serves as the electrical resistance for measuring the voltage drop, which is in inverse proportion to the thickness of the Cu coating. The instrument converts the measurement signal to coating thickness based on the probe characteristic.

Magnetic Method (Hall Effect)
(DIN EN ISO 2178)



Test Method Basics
Contact test method. A permanent magnet generates a constant magnetic field. The field strength will be proportional to the distance between the probe tip and the substrate. The magnetic field strength is measured with a Hall effect sensor, from this signal the coating thickness is calculated.

Beta Backscatter Method
(DIN EN ISO 3543, ASTM B567, BS 5411)

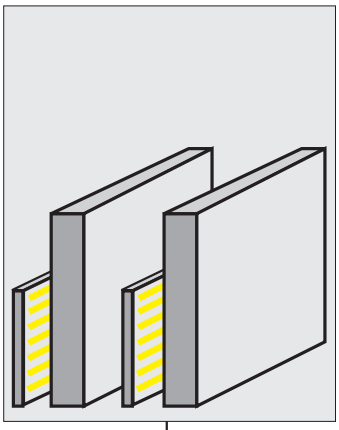


Test Method Basics
This method uses a Beta particle (electron) emitting isotope, an aperture and Geiger Müller tube detector. The isotope is located so that a collimated beam of Beta particles is directed through the aperture onto the coated test specimen. A portion of these particles is "backscattered" through the aperture to penetrate the window of the GM tube. The coating thickness is proportional to the rate of backscattered particles.

Test methods	Magnetic induction, Hall effect, Eddy current, modified Eddy current, electrical resistance, and Beta backscatter test methods for coating thickness measurement and the measurement of electrical conductivity and delta ferrite content in weld metal or duplex steels.
Hardware design	Clear functional keyboard design. Ergonomic and attractive housing; modular design concept for different test method module installation; the MMS® can easily be retrofitted with different modules as requirements change.
Measurement	All Fischer E-type smart probes, Beta backscatter measuring tables and hand held probes can be connected to probes the base unit. A maximum of 5 probes can be connected simultaneously.
Peripheral instruments	RS232 and parallel ports to connect a computer or printer. Connector for external start switch and control signal outputs for specification limit monitoring. Contact closures with external adapter.
Power supply	AC 11 V / 0.8 A from external A/C line adapter.
Dimensions	W x H x D: 350 x 140 x 190 mm (13.8“ x 5.5“ x 7.5“).
Weight	3 kg (6.6 lbs) when fully equipped.
Software design	User friendly menu driven interactive dialogue concept. Five softkeys with menu-sensitive functions. Linking of applications, security mode available. Calculation of the control limits for the SPC chart display. Outlier (freak measurement) rejection: automatic elimination of erroneous measurements, caused for example, by incorrect probe contact.
Data entry	Numeric entries and pre-programmed functions by keyboard, alphanumeric character entry from character matrix in the display for application and feature descriptions. Application and parameter selection with softkeys.
Display	Large high-contrast flat screen LCD display (126 x 70 mm, 5.0“ x 2.75“). Alphanumeric display to indicate active measurement module, active probe, date and time, measurement data, name of application, and selected feature (group identifications).
Measurement presentation choices	Large numeric display of the current reading plus window showing the previous 4 measurements with consecutive measurement number, or large numeric display of the current reading only, or graphic presentation of measurements within defined specification limits, or SPC control chart display ($\bar{x}$/R or $\bar{x}$/s chart), or difference measurement display (for measurement of specimens with multi-layered coatings). Unit of measurement selectable depending on the appliction: metric or U.S. units, Ferrite % or WRC-FN; Celsius or Fahrenheit; %IACS or MS/m conductivity units; free definition of a user defined unit.
Measurement capture	Automatic measurement capture with - accoustic signal after probe placement, - external start. Measurement capture in the continuous data display mode with a push of a button. Automatic periodic capture after probe placement with selectable time intervals. Automatic mean value capture after n measurements (n freely selectable). Ability to enter offset value to be subtracted from current reading. Deleting current or preceding measurement/measurement group. Corrective remeasure possible.
Data evaluation	Full statistical evaluation of measurement series with mean value, standard deviation, coefficient of variation, maximum and minimum, number of measurements, statistics of single readings or groups; calculation of process capability factors Cp and Cpk; outlier (freak measurement) rejection; histogram; probability chart with test for normal distribution; automatic grouping after n measurements and/or automatic final evaluation after N groups; group evaluation according to group numbers or group identifications.
Measurement data memory	Dynamically allocated data memory for a total of 20,000 measurements and 2,000 groups (blocks) that can be distributed into a maximum of 50 application memories. The application memory also stores the application parameter settings, normalization and corrective calibration parameters, application name, group identification (e.g. name, order number, batch name etc.), date and time.
Calibration	Normalization on bare substrate material. Corrective calibration on bare substrate material using 1 or 2 standards. Calibration on unknown coating (when bare substrate is not available). Master calibration on bare substrate with 4 standards to generate a new master probe characteristic for storage in the memory chip of the active smart probe (does not apply to plug-in testing module BETASCOPE®).
Documentation	Printout of single readings, block results and cumulative final results, specification limits, SPC control charts, histogram or probability chart. Customer specific print form with selection of the data to be printed can be generated and downloaded to the MMS® with separate PC software. Ability to store up to 5 different print form templates. Application-related on-line/off-line output of the measurement data via RS232 to external computer.

System Concept

Plug-in testing modules for various test methods



Adapter for contact closure output

Foot switch for external measurement triggering

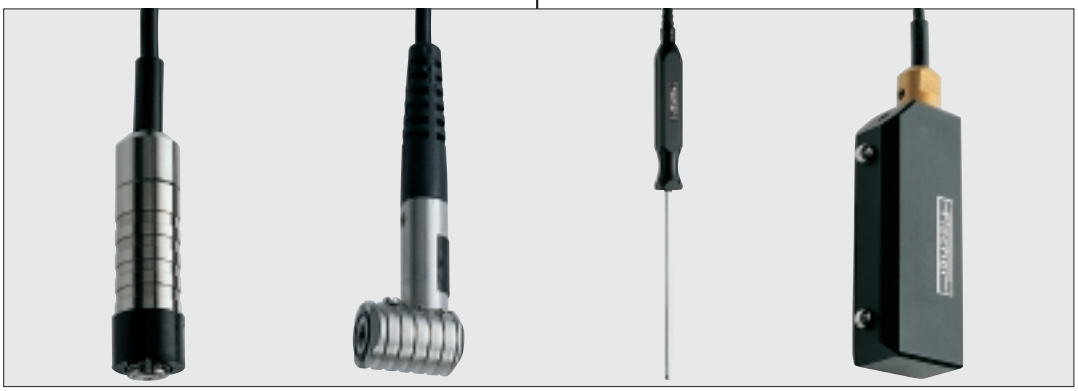
Measurement data transfer from FISCHER hand-held instrument to MMS®

Concept

The FISCHERSCOPE® MMS® features a modular design to offer each customer an instrument configuration that is just right for his application. The MMS® base unit is the heart of the system. Different probes and peripheral instruments can be connected to the base unit. Different plug-in testing modules are installed depending on the instrument version. From a broad assortment of probes, modules and other accessories the user can configure the FISCHERSCOPE® MMS® according to his particular measurement tasks.

Test Method Modules

Different plug-in testing modules are installed depending on the application. If additional applications are required at a later time, the instrument is retrofittable. The advantage of the modular system concept becomes immediately apparent: while in the past different instrument models were required for the various test methods, they can now be combined into one universal instrument.

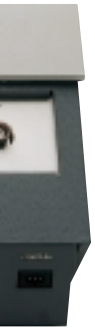


Probes and measuring tables for ...coating thickness measurements according to various test methods

... ferrite content measurement

Use external personal computer for:
- Data evaluation and storage
- Print form template design

Use a printer to document the measurement results



Documentation

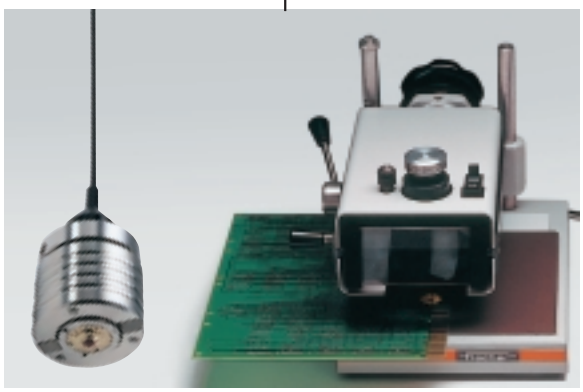
Every FISCHERSCOPE® MMS® features the interface(s) necessary to transfer data to a printer, PC or other data collecting device. Even data transfer to the MMS® from FISCHER hand-held instruments is possible.

Therefore measurements taken on site with the hand-held instrument can be transferred to the FISCHERSCOPE® MMS® using the instruments data management and evaluation capabilities.

Probes

The selection of the proper probe is important. Different probes can be connected to the FISCHERSCOPE® MMS®. Basically, the measurement system operates with any FISCHER E-type smart probe and with BETASCOPE® probes/tables. The flexibility of the instrument is in no way limited by the available probe choices considering that FISCHER continues to broaden the wide assortment of standard and special purpose probes.

... electrical conductivity measurement



... coating thickness measurement according to the Beta backscatter method

Universal and Flexible

A compact and extremly versatile desktop multi-function measuring system for non-destructive measurement, data archiving and measurement data processing applications. The operator can:
- measure coating thickness according to different non-destructive test methods.
- measure the electrical conductivity of non-ferromagnetic material.
- measure the ferrite content in austenitic and duplex steel.
- document, manage and evaluate data according to customer specifications.
- define control charts and evaluate measurement data using modern SPC/SQC methods.
- organize collected measurement data.

The extensive capabilities of this instrument make it one of a kind – worldwide. The MMS® system is frequently used for full control and monitoring of round the clock production processes. Millions of measurements have already been evaluated by users of the MMS® system. Automation of measurement processes, monitoring production and integration in a higher flow of information, e.g., as part of complex quality management system, are other uses of the MMS®.

The full statistical capabilities of the MMS® software provide for the evaluation of a few single measurements or series of thousands of measurements according to user defined criteria. Evaluation of the data according to certain criteria or transfer the data, e.g., to data base.

Easy to Operate

The FISCHERSCOPE® MMS® is easy to use. The instrument features a high contrast large area LCD display and tactile feedback keyboard. The operator can handle all measurement, storage, evaluation, and documentation tasks through an interactive dialouge with the system. Operation is simple, easy to learn, and uniform for all test methods. No matter which test method is employed, the user interface remains the same.

Plug-In Testing Modules

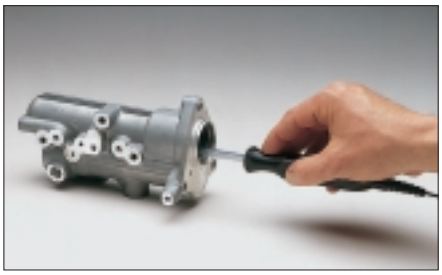
Different plug-in testing modules are installed depending on the application. If additional applications are required at a later time, the instrument is retrofittable.

Module PERMASCOPE®

- Magnetic induction method (DIN EN ISO 2178, ASTM B499).
- All type EG...; EK...; V1E...; V2E..., V6E... probes can be connected.
- Used to measure
  - non-magnetic coatings on ferrromagnetic substrates such as zinc, chromium, copper, tin, or paint, plastic, enamel on steel.
  - delta ferrite content in austenitic weld metal or duplex stainless steel.
- Eddy current method (DIN EN ISO 2360, ASTM B244).
- All type ET...; EA...; and the F/B container TM85 can be connected.
- Used to measure
  - electrically non-conductive coatings on non-ferrous metals such as paint, powder coatings, plastics on aluminum, brass, or zinc and anodized coatings on aluminum. Coating thickness measurement on the inside and outside of cylindrical tubes and beverage containers made of aluminum. Thickness of thin plastic foils.
  - poorly conductive non-ferrous coatings on electrically good conducting non-ferrous metals, such as chromium, or electroless nickel on copper, aluminum, or brass.

Application

- High volume electroplating
- Automotive industry
- Paint production and application
- Aerospace industry
- Chemical industry
- Structural steel engineering
- Metal industries



Examples of test specimens.

Module SIGMASCOPE®

- Modified Eddy current method.
- All type ES... probes can be connected.
- Used to measure
  - metallic coatings on electrically non-conductive or ferromagnetic substrates, e.g., copper on epoxy, zinc on steel, and nickel on steel.
  - the electrical conductivity of non-ferrous metals.

Application

- Aerospace industry
- Automotive industry
- Electrical and electronics industry
- Galvanizing and anodic plants
- Metal industries

Module DUPLEX

Note: works only in combination with module SIGMASCOPE®.

- Combination of magnetic induction and Eddy current method.
- All type ESG... probes can be connected.
- Used to measure
  - One-step measurement of the individual thicknesses of a paint/zinc coating system (duplex coating) on steel.

Application

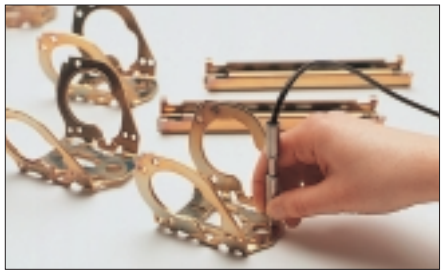
- Galvanizing plants
- Automotive supply industries
- Metal, sheet industries

Module NICKELSCOPE®

- Magnetic method (Hall effect, DIN EN ISO 2178).
- All type EN... probes can be connected.
- Used to measure
  - electroplated nickel coatings deposited on electrically non-conductive or non-ferrous substrates.
  - non-ferrous metal coatings, e.g., copper, aluminum, or lead coatings on steel (advantage: no Eddy current errors when measuring thick non-ferrous coatings).

Application

- Electroplating plants
- Automotive supply industries



Measurement of zinc coatings.

Module BETASCOPE®

- Beta backscatter method (DIN EN ISO 3543, ASTM B567, BS 5411).
- All BETASCOPE® measuring tables and hand-held probes combined with suitable isotopes and platen aperture rings can be connected.
- This test method offers a great deal of versatility and can be used to measure
  - paint, oil, lubricating films, plastic, enamel, ceramic and phosphate coatings on metals and some non-metals.
  - metal coatings on other metals and non-metals, including some coatings too thick for the X-ray test method.

Application

- PC-board and electronics industries
- Automotive industry
- Consumer products industry and others

Examples of test specimens.

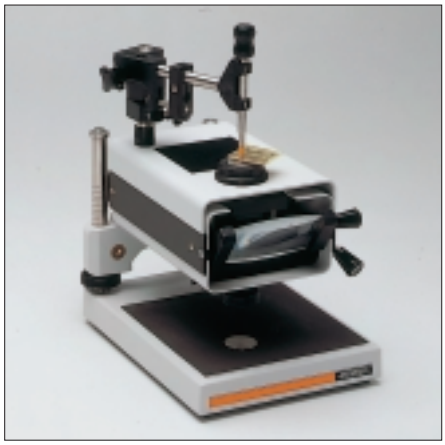
Measurement of synthetic corrosion prevention coatings on pipes using the probe EKB10.

The Beta Backscatter Method
is a proven and mature test method that for a number of applications is better suited than other non-destructive test methods. Electrical and magnetic properties do not influence the measurement.
Measurements can be made on areas as small as 0.12 mm (0.006“) in width and 1.2 mm (0.05“) in length. Basically, the module BETASCOPE® can be used to measure all coatings where the atomic numbers of coating and substrate differ sufficiently (a minimum of 20 %). These prerequisites are fulfilled for paint coatings on metal but also for many metal coatings, such as gold on nickel. For instance, gold coatings can be measured in a range of approx. 0.5 µm to 35 µm (20 to 1400 µin), and silver coatings even from 1 µm to 70 µm (40 to 3000 µin).

Measurement Ranges
The measurement range of the Beta backscatter method is generally determined by the energy of the isotope and the density of the coating material. In the table below, suitable isotopes and measurement ranges are listed for typical coating/substrate combinations. The measurement ranges refer to the so-called logarithmic range of the corresponding isotope, which is the range where the best measurement precision is obtained.

Isotope		PM-147	Tl-204	Sr-90	C-14
Coating	Substrate	Measurement range in µm (mils)			
Ag, Rh, Pd	Cu, Ni, Fe	1.2 - 4.0 (0.05 - 0.16)	5.5 - 22 (0.22 - 0.88)	15 - 70 (0.6 - 2.8)	-
Al	Cu, Ni, Fe	4.5 - 20 (0.18 - 0.8)	25 -100 (1 - 4)	90 - 400 (3.6 - 16)	-
Au	Cu, Ni, Fe	0.5 - 2.0 (0.02 - 0.08)	2.5 - 10 (0.1 - 0.4)	5.5 - 35 (0.22 - 1.4)	-
Cd	Cu, Ni, Fe	1.5 - 5.0 (0.06 - 0.2)	7 - 30 (0.28 - 1.2)	15 - 70 (0.6 - 2.8)	-
Cr	Al	2.0 - 8.0 (0.08 - 0.32)	8.0 - 30 (0.32 - 1.2)	-	-
SnPb(60/40)	Cu, Ni, Fe	1.1 - 4.5 (0.04 - 0.18)	5.0 - 28 (0.2 - 1.12)	10 - 80 (0.4 - 3.2)	-
Ni, Cu	Ag, Mo	1.5 - 5.0 (0.06 - 0.2)	9.0 - 30 (0.36 - 1.2)	20 - 100 (0.8 - 4)	-
Sn	Cu, Ni, Fe	1.8 - 5.5 (0.07 - 0.22)	7.5 - 35 (0.3 - 1.4)	15 - 100 (0.6 - 4)	-
Zn	Fe, Al	2.0 - 6.5 (0.16 - 1.2)	4.0 - 30 (0.16 - 1.2)	-	-
Paint	Ni, Cu, Al	11 - 40 (0.44 - 1.6)	50 - 200 (2 - 8)	80 - 800 (3.2 - 32)	3 - 11 (0.12 - 0.44)
Oil, lubricating films	Cu,Ni, Fe, Al, Mo, Ag, Au	-	-	-	1 - 11 (0.04 - 0.44)

The measuring tables and probes are application specific. Hand-held probes are available to measure coatings on bulky specimens, such as large circuit boards, sheet stock, or armatures and fixtures. Other probes are available to measure the coating thickness on the inside of tubes. Each measuring table operates in conjunction with the appropriate isotope and platen aperture ring. The FISCHER aperture ring is highly wear resistant and features a JEWEL-RING® platen. Slotted and round apertures are available. Different measuring probes, tables and isotopes have been designed to cover these varied applications.



Universal measuring table Z6NG with small parts accessory kit and weight pin.

Hand probe Z15NG to measure thin coatings (e.g., paint or primer coatings, oil- or lubricating films) also on cylindrical objects.

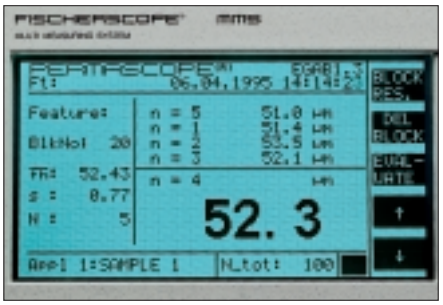
The angle probe Z11NG in combination with support stand V12 used to measure the coating thickness in bushings, pipes, bearing shells, etc. with diameters of 32 mm (1 1/4“) and up.

Measuring table Z14NG to measure the coating thickness on small parts with universal weight pin.

Hand probe Z9NG to measure the coating thickness of, e.g., armatures, printed circuit boards, sheet metal, etc..

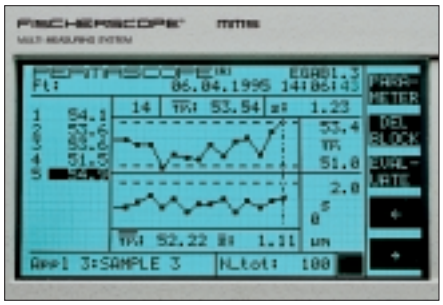
Display Mode, Evaluation

Large Numeric Display Mode



The easy to read data display allows the operator to discern important information immediately, positive avoidance of errors ..., all these aspects have been taken into consideration during the design of the instrument. The large numeric display mode allows reading of the measurement even from a distance. Only the information necessary for the measurement process is displayed. The last or selected measurement is enlarged allowing for clear readability.

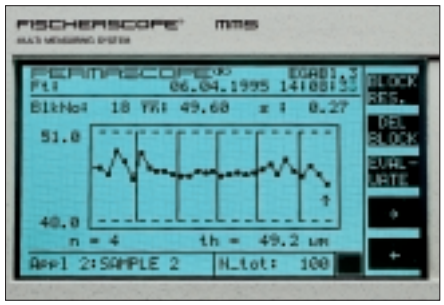
Control Chart Display Mode



Data presentation in the form of quality control charts can be used to monitor and control production processes (e.g., coating processes). The FISCHERSCOPE® MMS® evaluation software provides full SPC/SQC support capability.

The control chart can be printed if required. Process capability factors Cp and Cpk as well as Kurtosis and Skewness which are important to evaluate the process quantitatively, are calculated continuously.

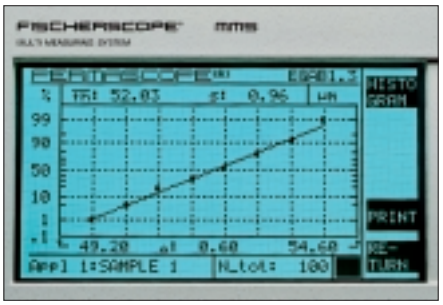
Specification Limit Display Mode



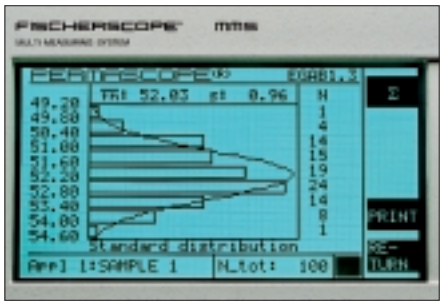
The specification limits are freely selectable to allow for control of the process to be monitored using the control chart display. Measurement subgroups are separated by vertical bars. Useful for, e.g., scanning object surface.

When a subgroup of measurements is finished, the subgroup evaluation data is displayed at the push of a button. The result includes number and percentage of measurements that violate the upper and lower specification limits.

Evaluation



Probability chart



Histogram

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 the application and or over a section of blocks. Graphical evaluation menus as histogram and normal probability chart are usefull for data analysis.The normal probability chart allows for a quick visual evaluation of the process, particularly useful to see if measurements follow a normal distribution.

Note: In this context, 'measurements' refers to the mean value of several single readings, e.g., of random samples. These mean values have a normal distribution according to the central limiting value theorem of statistics if no systematic values are present.

If the distribution is not normal, either the number of samples measured must be increased, or the process is not under statistical control, or the process is not normally distributed by nature. Suitable measures must be taken to eliminate possible assignable causes still present. Only when the measurements show normal distribution can the usual known rules for a capability evaluation be applied.

Print Form

Example for a customer specific print form

In today's quality conscious environment, user or customer specific documentation of the measurement result is a service the customer expects from his supplier. Often, documentation of the coating thickness and of other material properties is a stipulation.

In addition to the standard print form template included, a separate PC based program allows the creation and downloading of customer specific print form templates. In addition to the standard print form template up to 5 customer specific print form templates may be stored in the FISCHERSCOPE® MMS® and are readily accessible for final and batch results evaluation.

Application Example Electroplating Industry

The probe ESD2 is ideal for coating thickness measurements on very rough, electroplated surfaces.

In a plating shop, coating thickness measurements are performed on various customer parts with different shapes, sizes and material combinations. The FISCHERSCOPE® MMS® with module PERMASCOPE® is the ideal instrument for this environment. In this case, the MMS® can be equipped with

- probes suitable for the respective applications;
- suitable supports fixtures and a measuring stand to assure precise positioning of small test specimen, such as fasteners, stampings, etc;
- a personal computer for data acquisition to satisfy networking requirements or data analysis using third party software.

In the case of repetitive measurement tasks involving the same products, the proper application is retrieved at the push of a button which loads all application-specific calibration parameters. The measurement is performed in dialog with the measuring system. The operator can evaluate the measurements immediately or store the data in one of 50 application memories for later evaluation. When the measurement task is finished, a customer-specific measurement report can be printed. The print form template for this report is also saved in the specific application memory. The operator can focus on the task of measuring; the instrument performs all other functions.

Application Example Performance Critical Aluminum Alloy Components

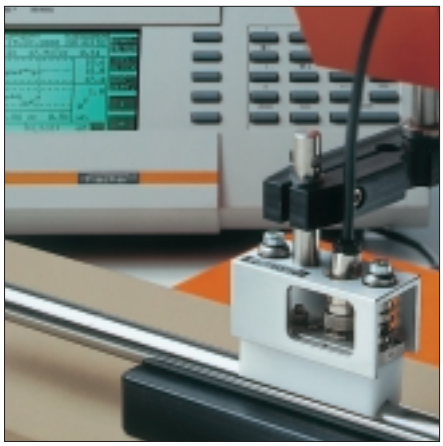
Decorative finishes as well as structural integrity can be measured.

Some aluminum alloy components used in the aerospace or automotive industries have a clearly defined spectrum of physical properties. Non-destructive measurement of the performance related structural condition of the component is required as part of a quality assurance program. Additionally, these components often receive some form of surface treatment: decorative finishes or anodic coatings (alloy wheels), hard anodizing (machine parts, extrusions), or electroplated finishes for certain applications. The FISCHERSCOPE® MMS® with the PERMASCOPE® and SIGMASCOPE® modules is ideal to control the quality of these coatings.

- The PERMASCOPE® module is used to measure the thickness of anodized and non-conductive coatings.
- The SIGMASCOPE® module is used to measure the electrical conductivity, which is closely related to structural condition and can be used as a correlating parameter for sturdiness. Additionally, this module can be used to measure chromium coatings on aluminum.

The versatility and measurement accuracy of the instrument make the FISCHERSCOPE® MMS® the ideal inspection tool for the quality control of many other performance critical coating applications.

Application Example Automated Measurement Device



Measurement of the chromium coating on pneumatic cylinders with the probe V2EGA06H mounted in the motorized support stand V12.

An uninterrupted, continuous testing of the coating thickness on all coated components can be realized only with fully automated measurement systems. Practical experience shows that this requires specially designed measurement probes. They must be able to withstand much greater continuous loads than manually used probes. Typical probes designed for manual measurements wear prematurely due to measurement cycles in rapid succession and the resultant overall significantly higher number of measurements within short periods.

The measurement probe V2EGA06H, that can be connected to the FISCHERSCOPE® MMS® with the PERMASCOPE® module is specifically designed for continuous measurements, and over long periods does not show indications of wear. Even after several million measurement cycles with automatic probe placement, e.g., using pneumatic cylinders, the measurements are accurate and reproducible such that even small coating thickness fluctuations along the surface line or the circumference of a cylindrical specimen, are still detectable.

In this manner, numerous measurement applications can now be fully automated and an uninterrupted 100% quality test can be realized, for example, in the chromium plating or galvanizing process of cylindrical components or sheet metal.

Quality Assurance for PC-Boards

For quality assurance, the coating thickness of Cu conductors and solder resists must be measured repeatedly. Pc-boards are highly complex products. Thus, the demands on testing instruments for quality assurance in the PCB industry are quite rigorous. The series FISCHERSCOPE® MMS® PCB easily meets the industry demands for measuring thickness of copper, other electroplated coatings and paint finishes.

FISCHERSCOPE® MMS® LRP specialty measuring system for quality assurance for pc-boards.

Cu Coating Thickness on Multilayers

Only a few methods are suitable for such measurements. The basic version with the already integrated electrical resistance method is specifically designed for this type of application. Particularly Cu coatings on thin laminates, the starting material for multilayer pc-boards, as well as on multilayers with epoxy interim coatings in a thickness range of 10 µm (0.4 mils) can only be measured accurately with the use of the electrical resistance method. This is the only method where the measurement result is not influenced by the underlying Cu coatings. With an appropriate calibration, measurements on small structures are possible as well.

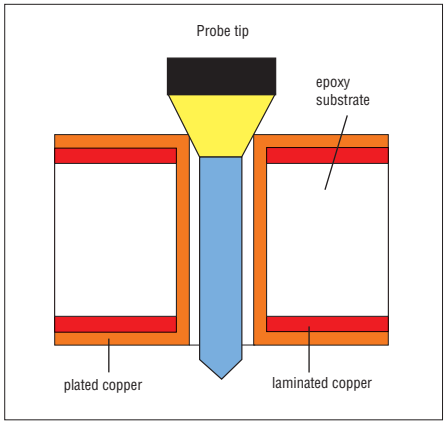
Measurement with the ERCU probe.

Cu Coating Thickness in Bore Holes

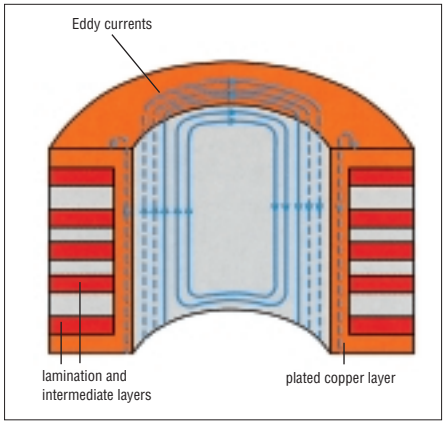
Expanding the basic version with the SIGMASCOPE® module results in the FISCHERSCOPE® MMS® PCB LR instrument model with the capability of having two different Eddy current probes connected at the same time.

The probe ESL08A can be used to measure the copper thickness in bore holes. To measure, the needle-shaped probe tip, which carries the actual measurement element, is inserted into the through hole. Interim layers do not influence the reading due to the specialty design of the probe (Eddy currents flow along the longitudinal axis of the hole).

Measurement of the copper thickness in through-holes of printed circuit boards, using the ESL08A probe.



The heart of the probe ESL08A is the measurement element in the needle-shaped probe tip, which is inserted into the through-hole to be measured.



The specialty probe design creates Eddy currents that flow essentially in the longitudinal direction of the copper sleeve. Thus any intermediate copper board layers have no influence on the measurement and the annular ring size has only a very small influence.

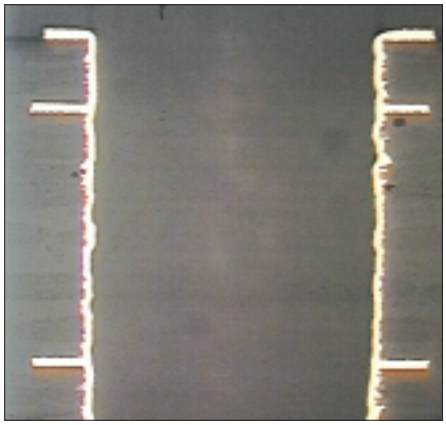
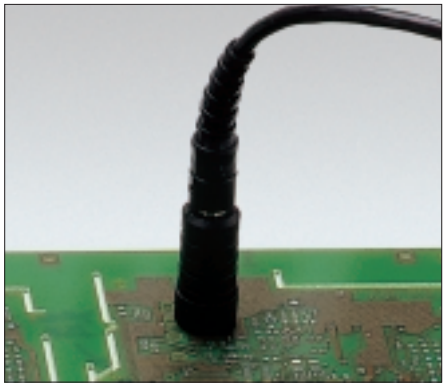


Photo of the micro section of a through-hole of a pc-board. Even this low magnification enlargement shows the irregularities of the copper layer.

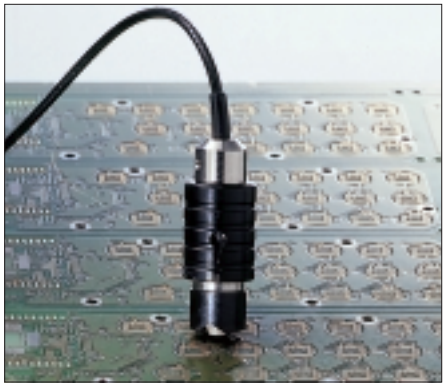
It clearly shows that the voids, which are result of fibers torn by drilling, were subsequently metallized. This effect also makes optical determination of the copper thickness more difficult.

Cu Coating Thickness on PC-Boards
Using the Eddy current probe ESC2, with the FISCHERSCOPE® MMS® PCB LR, the Cu thickness on the surface of pc-boards is easily measured (distance of copper layers located underneath must be greater than about 0.8 mm (32 mils)). The measurement is even possible through an applied solder resist coating.



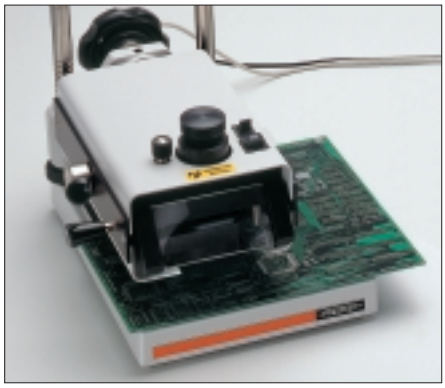
Measurement of the Cu thickness with the probe ESC2.

Solder Resist on PC-Boards
The expansion of, for example, the FISCHERSCOPE® MMS® PCB LR with the PERMASCOPE® module to the version FISCHERSCOPE® MMS® PCB LRP enables in connection with the Eddy current probe ETA3.3 the measurement of the thickness of solder resist on copper according to DIN EN ISO 2360 (copper thickness > 35 µm and diameter of test area > 6 mm).



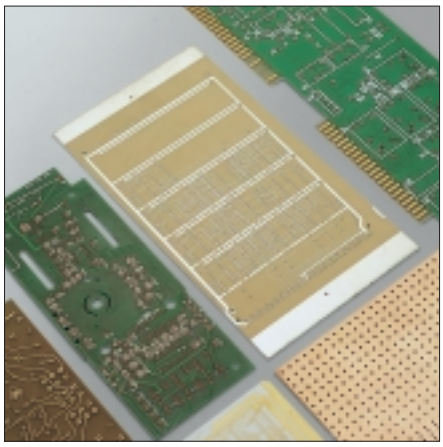
Measurement of the solder resist thickness with the probe ETA3.3.

Measurement on Small Areas
The beta backscatter method is particularly well suited for measurements on small areas and of Cu coating thicknesses between 10 and 35 µm (0.4 and 1.4 mils). To this end, the FISCHERSCOPE® MMS® PCB LRP is expanded using the BETASCOPE® to create the version FISCHERSCOE® MMS® PCB BLRP. The Beta backscatter method enables the precise measurement of the thickness of solder resist on pc-boards, the thickness of gold coating on contacts as well as the Sn or SnPb coating on conductor paths. The measuring stage Z6NG has proven itself over and over for such measurements. When using appropriate aperture rings, measurements on very small areas are also possible (ø ≥ 0.7 mm (28 mils)).



Measurement with the universal measurement stage Z6NG using isotpe PM147 and aperture ring ø 0.63 mm (ø 0.02“).

Application Example
Printed Circuit Board Manufacturing



In the full version, the FISCHERSCOPE® MMS® PCB BLRP can be utilized for versatile coating thickness measurements in pc-board production.

B The gold coatings on contacts, tinlead alloy coatings on solder pads and traces, and photo resist coatings are measured using the Beta backscatter method (BETASCOPE® plug-in testing module).

L Surface copper cladding thickness and copper plating thickness in through-holes is measured using the modified Eddy current method (SIGMASCOPE® plug-in testing module). Two Eddy current probes can be connected at the same time (e. g., ESL08A and ESC2).

R The copper thickness on laminates and multilayers is measured using the probe ERCU, which is based on the electrical resistance method, without any influence from the copper coating on the opposite side.

P The thickness of solder resist on copper is measured using the Eddy current method (PERMASCOPE® plug-in testing module).

A centralized measurement system can perform all of these measurement tasks by simply selecting the proper application. Uniformity of operation regardless of the test method selected keeps operator activities to a minimum. The measurement data can be stored, evaluated, printed or downloaded to an external computer. The FISCHERSCOPE® MMS® PCB BLRP offers the PC-board manufacturer an economic method to efficiently measure all his applications.

Ordering Information

Basic Versions (with one testing method each)	Order No.
FISCHERSCOPE® MMS® PERMASCOPE®	602-110
FISCHERSCOPE® MMS® DUPLEX	602-251
FISCHERSCOPE® MMS® NICKELSCOPE®	602-217
FISCHERSCOPE® MMS® SIGMASCOPE®	602-156
FISCHERSCOPE® MMS® BETASCOPE®	602-155
Plug-in Testing Modules	
PERMASCOPE® plug-in testing module (8/8*)	602-264
DUPLEX plug-in testing module (14/19*)	602-268
NICKELSCOPE® plug-in testing module (14/19)*	602-265
SIGMASCOPE® plug-in testing module (14/19)*	602-266
BETASCOPE® plug-in testing module (5/2)*	602-267
TF100 plug-in testing module for connecting a temperature probe	602-366
* required probe connector module Note: Any up-grade of the basic instrument versions with additional plug-in testing modules is possible. Any one of these modules can be installed. Plug-in testing module DUPLEX requires the plug-in testing module SIGMASCOPE®!	
Connector Modules	
Connector MMS® module 8/8	602-272
Connector MMS® module 14/19	602-273
Connector MMS® module 5/2	602-271

Basic Versions of FISCHERSCOPE® MMS® PCB	Order No.
FISCHERSCOPE® MMS® SR-SCOPE, includes the electrical resistance test method	603-017
FISCHERSCOPE® MMS® PCB L, includes SIGMASCOPE® plug-in testing module (electrical resistance method cannot be retrofitted!)	602-737
Plug-in Testing Modules	
PERMASCOPE® plug-in testing module (8/8*)	602-264
SIGMASCOPE® plug-in testing module (14/14*)	602-266
BETASCOPE® plug-in testing module (5/2*)	602-267
* required probe connector module Note: Any up-grade of the basic instrument versions with additional plug-in testing modules is possible. Any one of these modules can be installed. Please note: the basic version FISCHERSCOPE® MMS® PCB L can not be retrofitted with the el. resistance method!	
Connector Modules	
Connector MMS® module 8/8 (only neccessary for basic version FISCHERSCOPE® MMS® PCB L)	602-272
Connector MMS® module 14/14	602-273
Connector MMS® module 5/2	602-271

Accessories	Order No.
Support Stand V12 Motorized MMS	602-855
Support Stand V12	602-260
Magnetic Fixture for Support Stand V12	600-019
Test Station TM 85 (F/B container measuring system TM85)	602-546
Measurement Fixture for Screws	602-916
Jig for Angle Probes for use with the Support Stand V12	600-077
Jig for Inside Probes for use with the Support Stand V12	600-691
Adapter 19/8 MMS X, for connecting a second magnetic induction or Eddy current probe (DUPLEX plug-in testing module neccessary)	602-479
Adapter for Contact Marker	602-270
Footpedal MMS	600-152
MMS Battery	602-731
NC-Charger MMS	602-732
Carrying Bag MMS	602-809
Carrying Case MMS small	603-003
24-Pin Printer F3200	602-436
Interface MMS/PC-AT Set	602-220
Interface Cable MMS/MP30(40)	602-386
Interface Cable MMS/MP0S	602-387
Report Software MMS	602-388
Software PC-DATEX (english), for transmitting data into EXCEL® tables	602-476
Software PC-DATACC (english), for transmitting data into ACCESS® data base sheets	603-054
Temperature Sensor TF100	602-365

Accessories Module BETASCOPE®	Order No.
Universal Measuring Table Z6NG**	602-261
Measuring Table Z14NG**	602-250
Hand Probe Z9NG**	600-460
Angle Hand Probe Z11NG**	600-471
Hand Probe Z15NG, works only with isotope C-14	602-787
Small Component Fixture Set for Z6NG	602-371
Adapter Beta 32 mm, for Z6NG to fit isotope and aperture platen	600-550
Centering Device for Z9NG	600-461

** Choose required Beta isotope from table below.

Beta Isotopes

The table below contains all standard isotopes,
others are available on request.

Type	Aperture opening	Energy	Half life	Order No.
Pm-147	ø 0.63 mm (0.02“)	0.22 MeV	2.65 years	600-488
	0.63 x 1.2 mm (0.02 x 0.05“)			600-489
Tl-204	ø 0 63 mm (0.02“)	0.76 MeV	3.65 years	600-490
	0.63 x 1.2 mm (0.02 x 0.05“)			600-491
Sr-90	ø 1.6 mm (0.06“)	2.27 MeV	28 years	600-492
C-14	ø 20 mm (0.79“)	0.156 MeV	5680 years	600-493

Probes

The measurement accuracy of the FISCHERSCOPE® MMS® is determined primarily by the proper choice of measuring probe. FISCHER offers a broad assortment of probes for various applications. The type E... FISCHER probes contain a memory chip in the probe plug that stores the master calibration of the probe. Therefore the probe is immediately ready to measure when connected to the instrument. The table to the right shows a selection of standard probes. More detailed specifications can be found in the probe catalog (Order No. 902-052).

Probe Selection

Proper probe selection determine the quality of the measurement. Probe selection is determined by various criteria.

- Coating/substrate material combination determines the test method – magnetic (Hall effect), magnetic induction, Eddy current or electrical resistance.
- Thickness of coating and substrate are also important for the selection of the test method used. The measurement range is determined by the coating thickness.
- Geometric configuration of the measurement area. The probe shape is determind by the geometric configuration of the measurement area. Radial, axial, and right angle probes are available. These probe designs allow for easy measurements on the inner and outer surfaces of the specimen. The curvature of the measurement area is another aspect to be considered.
- The surface roughness of the measurement area should be taken into consideration; for instance, two-pole probes will usually tender better results on rough surfaces than single-pole probes.

Magnetic Induction Probes to Measure the Coating Thickness

Design	Type	Meas. range µm (mils)	Order No.
	EGAB1.3*	0 - 2000 (0 - 80)	601-793
	EGABI 1.3-150	0 - 1000 (0 - 40)	601-932
	EKB10	0 - 8000 (0 - 320)	602-225

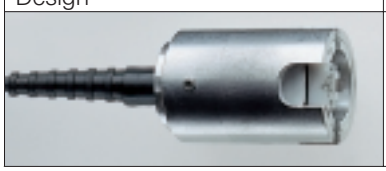
Magnetic Probes to Measure the Coating Thickness

Design	Type	Meas. range µm (mils)	Order No.
	EN3*	0 - 150 (0 - 6) Ni/NE, Iso 100 - 4000 (4 - 160) NE/Fe	602-305

Eddy Current Probes to Measure the Coating Thickness

Design	Type	Meas. range µm (mils)	Order No.
	ETA3.3	0 - 1200 (0 - 45)	602-797
	ETA3.3H	0 - 1200 (0 - 45)	602-128
	EAW3.3	0 - 1200 (0 - 45)	602-025
	EAI3.3-150	0 - 800 (0 - 32)	602-026
	ETD3.3	0 - 800 (0 - 32)	602-607
	EA30	0 - 20.000 (0 - 800)	602-027
	ESD2	Cu/Fe: 0 - 80 (0 - 3.2) Zn/Fe: 0 - 200 (0 - 8) Ni/Fe: 0 - 50 (0 - 2)	602-308
	ESC2	Cu/Iso: 0 - 90 (0 - 3.6) Cr/Cu: 0 - 200 (0 - 8)	602-237
	ESL08A	5 - 80 (0.02 - 3.2)	602-224
	ESG2	0 - 800 (0 - 32) 0 - 100 (0 - 4)	602-311

Electrical Resitance Probe to Measure the Coating Thickness

Design	Type	Meas. range µm (mils)	Order no.
	ERCU	Cu/Iso: 0 - 10 (0 - 0.4) 5 - 120 (0.02 - 4.5)	602-616

NE: non-ferromagnetic material; Iso: electrically non-conductive and non-ferromegnetic materials
Cable length: 1.5 m (590"); longer cable length on request.
** Also available as right angle probe, same design as EWA3.3.*

The operator can correct for differences in magnetic properties (permeability) or in the electrical conductivity, and for specimen shape related geometric influences through a simplified user calibration. In most cases, only one calibration standard and the bare substrate need to be measured. In extreme cases, where very unusual material property or geometric effects are encountered, a two-point or even a master calibration can be performed. Application-specific user calibration parameters are stored in the application memory of the measurement system, thus avoiding the need for user recalibration when switching applications.

Eddy Current Probes to Measure the Electrical Conductivity

Design	Type	Meas. range	Order No.
	ES1A	0.3 - 63 MS/m 0.5 - 108 %IACS	602-222
	ES2	0.3 - 63 MS/m 0.5 - 108 %IACS	602-223

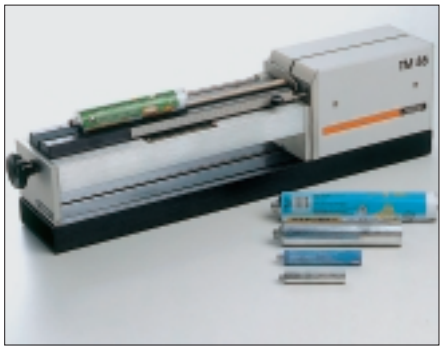
Magnetic Induction Probes to Measure the Ferrite Content

Design	Type	Meas. range	Order No.
	EGAB1.3-Fe*	0 - 80 % Ferrite 0 - 110 WCR ferrite number	602-221

Cable length: 1.5 m (590"); longer cable length on request.
** Also available as right angle probe, same design as EWA3.3.*

Specific Probe Designs for Custom Applications

Probe placement system assures indentation free probe positioning for automatic measurement high volume measurement applications, or automatic measurements on strip, sheet, etc., or to avoid indentation errors on very soft coatings. Easy integration into production lines for 100% testing.



F/B container measuring system for coating thickness measurement on the inside and outside of cylindrical tubes and beverage containers made of aluminum.

Piston ring measuring table V4EKB4.

Measurement Fixtures

For special applications, measurement aids such as placement fixtures, probe stands and other attachments are available to complement the broad variety of probes that can be used with the FISCHERSCOPE® MMS®. The two figures on the right show measurement aids from the extensive assortment available.

Support stand V12 with magnetic fixture and adapter 601-691 with mounted inside probe EGABI1.3-150.

Measurement fixture for screws.

Active Around the World

FISCHER is a leading multi-national company in the field of electronic coating thickness measurement and materials testing instruments. The company is able to recommend the best coating thickness measuring instrument for any application, due to the company's extensive experience in this field. The wide range of instruments includes models for coating thickness measurements according to the X-ray fluorescent, Beta Backscatter, magnetic induction, eddy current and coulometric methods. Additionally, the program includes instruments for measuring microhardness, ferrite content, and porosity testing. FISCHER is active around the world. Instruments manufactured by our company are used in many countries. FISCHER has subsidiaries in eight different countries.

FISCHERSCOPE® X-Ray to measure the coating thickness according to the X-Ray fluorescence method.

Micro hardness measurement unit FISCHERSCOPE® H100C.

DUALSCOPE® MP40 with probe ED10 to measure coating thickness on ferromagnetic, as well as non-ferromagnetic materials with automatic recognition and selection of the measurement method.

The high quality standard of FISCHER instruments is the result of our efforts to provide the very best instrumentation to our customers.

FISCHER is a reliable and competent partner, offering expert advice, extensive service, and training seminars.

Today, FISCHER instruments are used successfully in all technological fields of industry and research.

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