FISCHERSCOPE®
Fischer newsletter Great Britain
No. 1/11

«editorial»

Dear Reader,

Welcome to another copy of FISCHERSCOPE®, the Fischer newsletter for Great Britain direct to your desk. Again this issue of FISCHERSCOPE® will inform about new and interesting applications across our diverse customer base.

The demand for precise and reliable measurements of coating thicknesses or of alloy contents exists in many industries or research institutes. This edition deals with applications in jewellery and the precious metals industry, the paint and automotive industry and the electroplating industry.

The jewellery topic describes the use of the X-Ray fluorescence instrument XAN® 120 designed for quick scrap jewellery or scrap industrial testing – quite helpful with the high price of gold nowadays, especially with a precision of <0.1wt% for gold. This edition also explores the practical measurement of differing layer compositions as those presented by a shower head and the very latest in FISCHER'S probe technology.

Fischer Instrumentation (GB) Ltd also offers regular customer seminars for education and training – have a look on the last page of this newsletter. Give a us a call if you are interested in attending our next seminar.

Despite all the signs of growth in the UK, the impacts of successive natural disasters have a knock on effect for worldwide trade and global supply chains, making it ever more important to make the right business decisions. FISCHER manufacture for the stringent quality control standards of its customers and a serviced FISCHER product will stand the test of time. A business decision no one will criticise.

We hope you enjoy reading your issue of FISCHERSCOPE®

The team at Fischer Instrumentation (GB) Ltd, Lymington, Hampshire

«information from practice»

Welcome – Fischer GB's New General Manager

The Helmut Fischer Group is pleased to welcome Peter Ho as General Manager of Fischer Instrumentation (GB) Ltd. Peter will be responsible for Fischer's UK core markets and the strategy to identify and develop other markets in line with ongoing technical innovations from Germany.

Peter comes to Fischer Instrumentation with fifteen year experience in the management and sales of capital test equipment, encompassing servo hydraulic systems, controls, software and services. With extensive experience in motorsports and automotive, Peter also has sector experience in aerospace and civil engineering, all on an international scale.

Peter has spent the last five years as Vice President of North American Operations for Servotest, where he established a manufacturing base and built up a contract testing facility as well as increasing sales and service business there.

A solid background of engineering and sales and marketing will put Peter in a good position to develop growth opportunities for the UK.

Ongoing Technical Innovations from Germany

The new ESG20 Universal Probe offers practical measurement of the coating thickness of duplex coatings for car bodies and is proving a must on every shop floor. Read more on page 3.

Fischer's Cavity Probe launched this year is another extremely practical solution for all those hard to reach cavity areas in car production. The concept behind the Cavity Probe is explained on page 7.

The development of probe technology continues with a variety of solutions to the problem of measuring the thickness of magnetic coatings. Peter Neumaier discusses this subject on page 6.

Duplex Probe ESG20

FISCHERSCOPE® X-RAY XAN® 120
Ideal for the analysis of jewellery and precious metals

Rising raw materials prices mean that the analysis of precious metal alloys is becoming increasingly important. It is now important for both the producers and the trade to determine the content of precious metals in jewellery, dental and technical alloys. The challenges arising from this, in particular the need even to analyse unknown specimens with large numbers of accompanying elements, must be mastered by measurement technology. The easy-to-use and highly reliable FISCHERSCOPE® X-RAY XAN® 120 is designed perfectly for this application. Even gold/platinum alloys can be analysed with good precision and low contents of precious metal can be detected with the high-resolution semiconductor detector. The 1 mm diameter aperture ensures sufficiently high X-Ray count rates so that precious metals can be measured with good precision, even for measuring times of 60 seconds.

Alloy	Standard deviation Gold in %
Au999.9	0,044
Au900Ag50Cu50	0,10
Au750Ag50Cu200	0,093
Au750Ag50Cu100Zn100	0,13
Au750Ag100Cu150	0,12
Au750Ag150Cu100	0,088
Au750Pd100Cu80Ni70	0,13
Au585Ag45Cu370	0,11
Au585Ag300Cu115	0,10
Au585Ag275Pd140	0,13
Au333Ag75Cu470Zn122	0,096

Table 1: Repeatability of the gold content for some typical alloys. Each alloy was measured 20 times with a measuring time of 60 seconds.

	Ref. mat. 750		Ref. mat. 585		Au585 ring	Pendant
						
	Measurement	Reference	Measurement	Reference	Measurement	Measurement
Au	75,11	75,06	58,38	58,38	58,39	33,37
Ag	9,95	9,88	29,56	29,60	20,22	0,82
Pd	– 0,004	—	– 0,005	—	– 0,04	– 0,04
Cu	14,96	15,06	12,06	12,02	21,29	51,12
Zn	- 0,004	—	- 0,01	—	0,11	11,45

Table 2: Measurement results for various jewellery gold alloys with a calibrated measurement job. Each specimen was measured 5 times for 60 seconds.

	Alloy 1		Alloy 2	
	Measurement	Reference	Measurement	Reference
Au	70,26	70,0	74,49	74,5
Pt	3,93	3,9	10,20	10,2
Ag	13,05	13,0	1,63	1,7
Pd	2,05	2,0	10,42	10,0
Cu	9,60	9,5	0,13	0,1
Zn	1,55	1,5	0,05	—
Sn	– 0,23	—	0,32	0,5
In	– 0,10	—	2,78	2,9

Table 3: Standardless measurement results for two dental alloys. Each alloy was measured 5 times with a measuring time of 60 seconds.

Table 1 shows results for a selection of often used gold alloys. The repeatability of the device in this case is, on average, around 0.1% for a measuring time of 60 seconds. Analysis on the basis of the fundamental parameters method using WinFTM® software and optional calibration ensures high accuracy of the results of measurement. Some examples of jewellery gold alloys are shown in Table 2. The measurement job applied was calibrated with a set of certified standard materials supplied by Helmut Fischer GmbH. If comparable standards are now measured, the results show a deviation of less than 0.1% from the reference values. The positioning and the geometry of the specimen are, however, also important in the accurate measurement of real jewellery items in addition to suitable analysis. The geometry of measuring from below used on the XAN® 120 in combination with the video microscope to show the precise measuring point helps here: the specimen can be correctly placed quickly and easily.

It is not always possible to calibrate with a reference material. There are often no reliable standards for alloys, in particular those with many accompanying elements. This demonstrates that the standardless fundamental parameter method also yields very good results. Table 3 demonstrates this with an example of two alloys used in dentistry. In addition to the principal elements, the accompanying elements can be reliably measured down to a concentration range of 0.1%. ■

Dr. Bernhard Nensel

Practical measurement of coating thickness of duplex-coatings for car bodies using the ESG20 universal probe

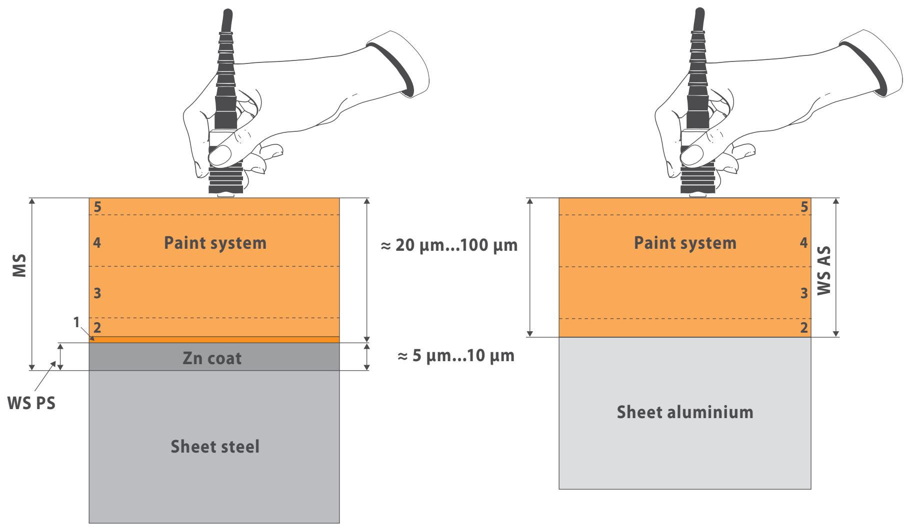
Quality control of painting processes in automobile manufacture is becoming increasingly important. The requirements on efficient corrosion protection and paint quality are growing with the simultaneous target of reducing costs, for instance. This has led to a reduction in the Zn coating thickness on galvanised steel car body parts, for instance, and a tightening of the tolerances on thickness for the individual paint coating. This process becomes even more complex with the different methods of galvanising the steel parts used, the additional further corrosion protection measures and the increase in the use of substrate materials other than steel, e.g. aluminium. The subsequent painting process for all these different parts and methods must be monitored efficiently and compliance with the tolerances must be ensured.

The traditional approach to measuring the individual paint layers on galvanised steel parts using a magnetic inductive sensor, with the zinc thickness being deducted as a value assumed to be constant, cannot meet these current requirements. Even within the same car model, the zinc coating thickness can vary greatly because of the different suppliers of the body parts and be further changed by subsequent forming operations. The separate measurement of thin electrophoretic dip applied coatings (see Case 1 component (2) of the paint system, e.g. 20 µm) in particular, therefore, demands precise measurement of the zinc coating (approximately 5-10 µm) to allow verification of compliance with the thickness tolerances demanded. At the same time, however, it should be possible to measure paint coatings on aluminium, if possible without needing an additional sensor. The ESG20 probe was therefore developed specifically for these requirements in automotive production. It is a combination of a sophisticated phase-sensitive eddy current sensor and a magnetic-inductive sensor that is capable of automatically carrying out many typical measuring jobs (duplex-mode application, cf. Figure 1):

1. Paint system/zinc/steel) simultaneous, very precise measurement of the zinc coating and the coating thickness of the paint system; Paint and zinc coating thicknesses are shown in the display.
2. (Paint system/aluminium) measurement of the paint coating thickness on aluminium parts.

Typical example of a paint system:
(1) Zinc phosphate (≈ 1 µm)
(2) Electrophoretic dip coating (≈ 20 µm)
(3) Primer coating
(4) Top coating
(5) Clear lacquer

MS = magnetic-inductive channel
WS PS = phase-sensitive eddy current channel
WS AS = amplitude-sensitive eddy current channel



Case 1: Paint system/zinc/steel
- Measurement of the zinc coat thickness (electrolytic or dip coating) 5 – 10 µm on sheet steel
- Measurement of paint system thickness with structure (1) (2) (3) (4) (5). Main interest electrophoretic dip coating layer of ≈ 20 µm and total thickness of paint system

Case 2: Paint system/ aluminium
- Measurement of paint thickness with system structure (2) (3) (4) (5), total thickness of paint system

Figure 1: Typical measurement jobs in automobile manufacture, carried out with the ESG20 sensor.

Figure 2: PHASCOPE® PMP10 DUPLEX with ESG20 sensor in practical use in automotive production (factory photo: VW).

Figure 3: Mobile use of the PMP 10 DUPLEX unit directly in the production area of the paint shop (factory photo: VW).

The substrate material is detected automatically by the sensor, i.e. the operator need not worry whether he is measuring the paint thickness on galvanised steel or on aluminium parts. The zinc coating is measured with high precision in Case 1 by the phase-sensitive eddy current method through the paint coating (lift-off compensation).

Practical software algorithms ensure that this eddy current probe can be calibrated without additional zinc reference standards. If, on the other hand, the measurement is being taken on aluminium parts in Case 2, special conductivity compensation ensures that different aluminium alloys (variation in conductivity) have no influence on the measurement of the paint thickness. The correct coating thickness is always measured very precisely and reproducibly without additional calibration.

Other manufacturers have employed dual probes for further measuring jobs in the past. To avoid additional measuring systems being required for these applications, the ESG20 probe can also be operated in a dual mode (select the dual mode application). Thus, the sensor can also carry out the classical measuring jobs of «paint/steel» or «paint/aluminium» with automatic detection of the substrate material.

The ESG20 may therefore be used as a universal sensor, tailor-made for process control in automotive production. ■

Dr. Hans-Peter Vollmar

We thank Volkswagen AG Wolfsburg for making the photographs available.

«information from practice»

Measurement of Cr/Ni/Cu coatings of a shower head

Figure 1: Shower head positioning in the FISCHERSCOPE® X-RAY XDLM®.

A shower head generally has a glossy silver appearance, one might assume solid metal. However, the substrate is very often plastic. The typical layer composition is chrome/nickel/copper on a plastic substrate.
The decorative chrome coatings are in the region of 0.5 µm or even less, the nickel coating is 5 – 10 µm, the copper layer is up to 30 µm or even thicker.
The x-ray fluorescence (XRF) method is a non-destructive method of measurement to be used. Figure 1 shows the measurement set-up on a FISCHERSCOPE® X-RAY XDLM®. A measurement application determining the chrome, nickel and copper coatings on a plastic component was used to carry out the measurement.

The following points must be considered in this measurement:
alignment of the specimen to the detector (proportional counter tube)
The measurement should always be taken at the highest point. In addition, it is important to know how the detector is aligned in the measuring device. If the shower head is arranged longitudinally to the detector, smaller displacements of the measuring position do not have such great effects on the result.

Figure 2: Measuring points for XRF and coulometric measurements.

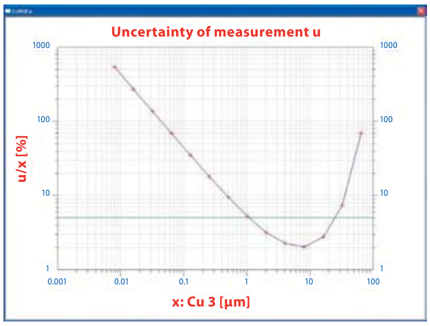


Figure 3: Estimate of the measuring range for the copper coating (WinFTM® simulation).

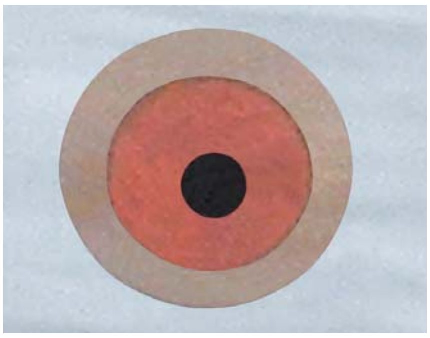


Figure 4: Coulometric removal in 3 steps: Cr/Ni/Cu

Avoid tilting

The specimen must not be tilted, i.e. the point to be measured must be absolutely horizontal. Particular attention must be paid to this requirement as there are often no flat surfaces on the specimen.

Correct video focusing on the measuring point

If the focus is not correct at the measuring point, the analytical software will assume an incorrect measuring distance. This can lead to faulty measurements.

XRF saturation thickness

There are physical limits to XRF measurement. If the coating thickness is too great, there is a risk of saturation. This limit can be estimated on devices with WinFTM® software for an existing measuring application.

In Figure 3, the measuring range limit was determined for the copper coating, on the assumption that the copper and nickel finishing coatings are 0.2 µm and 7.5 µm thick respectively. The measuring range for the copper coating beneath these is approximately 1 to 25 µm.

If all points are taken into careful consideration, the shower head can be measured non-destructively by XRF.

There is also the alternative option of determining the layer thicknesses of Cr/Ni/Cu coats coulometrically. In this method, the coatings are successively removed at the measuring area and the coating thickness determined in the COULOSCOPE® CMS by way of the time taken for removal. Table 1 shows the coating thicknesses measured: in the XRF method, four locations were measured around the each of the coulometric measuring area . The coulometric results each consist of a measurement for each coating element. The values measured for the two methods are very close to one another, but a practised observer would note that the methods do not come to exactly the same results. The reasons for the differences may be found in the positioning of the specimen in XRF measurement; inhomogeneities in the coatings may also play a role. In the case of copper, it is also true that the specimen is close to the XRF saturation thickness and that measuring inaccuracy increases strongly as a consequence.

The COULOSCOPE® CMS offers the capability of measuring copper coatings up to approximately 50 µm thick. The coulometric method can thus represent an important complement to the XRF method. ■

Dipl.-Ing. (FH) Wolfgang Ziegler

Measuring point	1	2	3	4	5
FISCHERSCOPE® XDLM®					
Measurement duration 30 seconds					
Cr average	0,17	0,17	0,17	0,17	0,16
Standard deviation	0,003	0,005	0,005	0,004	0,005
Ni average	7,24	7,40	7,10	7,29	7,21
Standard deviation	0,07	0,04	0,10	0,11	0,07
Cu average	21,40	21,90	22,10	20,10	20,60
Standard deviation	0,25	0,39	0,29	0,29	0,26
Number of measurements	4	4	4	4	4
Couloscope® CMS					
Duration of a measurement 3 x 2 min					
Cr	0,17	0,16	0,17	0,16	0,16
Ni	7,50	7,60	7,60	7,20	7,50
Cu	22,10	22,70	22,00	21,90	22,50
Number of measurements	1	1	1	1	1

Table 1: Comparison of measurement results on the shower head.

Measurement of the thickness of magnetic coatings – a challenge?

This somewhat provocative question is resolved with respect to the use of a magnetic or magnetic-inductive measuring system. Coatings of nickel or iron (or their magnetic alloys) were considered on decorative or technical surfaces, applied by galvanising, deposition or rolling etc. on plastics or non-ferrous metals or directly electroplated on steel or iron without an intermediate copper coating. The problems in this measuring job are caused by the magnetic properties of such coatings which generally fluctuate widely as a function of the way in which they are applied. The measurement is thus influenced by two parameters: the coating thickness and its magnetic permeability. However, only one parameter can be determined by the methods of measurement considered here. In the case of coating thickness measurement, the permeability of the reference part (calibration standard) and the parts to be measured must be constant. The user must therefore produce his calibration standards himself.

There are two applications:

Coatings on plastics or non-ferrous metals.

This is the «simpler» measuring job, as the substrate is non-magnetic. Given the conditions of a relatively large area to be measured; a coating material that is homogenous (Figure 1) or porous (Figure 2), such as thin-film deposited coatings, for instance, the **EN3** and **FN4D** probes are preferably used.

The amplification of the magnetic field of a permanent magnet by the permeability of the coating is determined here using a Hall-effect sensor.

The relationship between amplification and thickness is stored in the sensor characteristic. The **FGAB1.3-Ni** magnetic-inductive probe should be used for a relatively small area measured (e.g. diameter only approximately 3 – 4 mm) and a pore-free coating (Figure 3).

The measuring effect here is based both on the amplification of the low-frequency magnetic alternating field of the probe and on the formation of eddy currents preferentially in the coating. Eddy currents in the non-ferrous metal substrate may be ignored because of their low frequency. Pores in the coating would have a negative influence on the formation of eddy currents there, and hence on the measuring effect.

Coatings on steel and iron

Only electroplated nickel coatings may be considered for measurement here (Figure 4). Reason: the permeabilities of the coating and substrate must differ by a sufficient amount. Electroplated nickel coatings have a permeability that is some 3-5 times lower than normal iron or steel substrates because of the chloride content and other additives in the bath and because of lattice tensions. This difference may be detected and converted into a coating thickness value using the **ESD20Ni** phase-sensitive eddy current probe.

These considerations show that this truly is a difficult measuring job and the appropriate measuring system must be selected with care. ■

Dipl.-Ing. Peter Neumaier

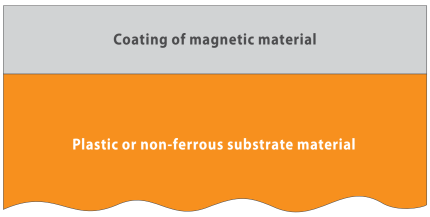


Figure 1: *Large measuring area. Homogeneous coating material.*

Probe: EN3, FN4D

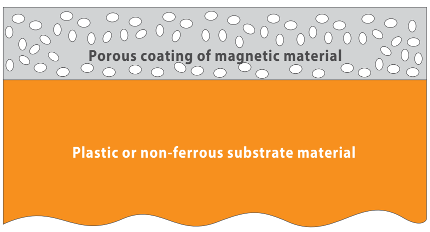


Figure 2: *Large measuring area. Porous, non-homogeneous coating material.*

Probe: EN3, FN4D

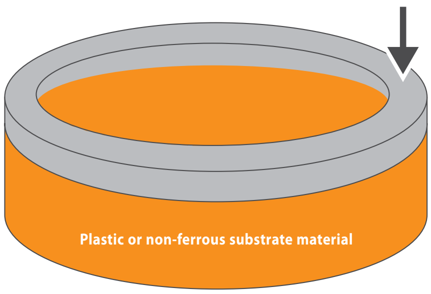


Figure 3: *Small measuring area. Homogeneous coating material.*

Probe: FGAB1.3-Ni

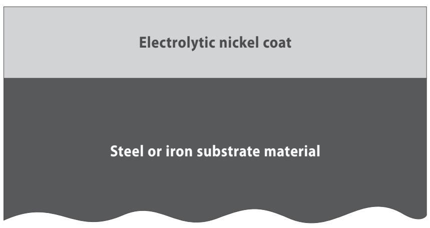


Figure 4: *Homogeneous coating material.*

Probe: ESD20Ni

Non-Destructive Measurement of Protective Coatings in Car Bodies Cavities

Modern car bodies are nowadays mostly protected with Cathodic Dip Painting (CDP) against corrosion. However, it has been almost impossible to measure this thin layer of varnish precisely in hard to reach cavities such as pillars, sills, beams and bracings, without destroying the part to be measured. Measured thicknesses are typically between 15µm and 20 µm at those spots. Coating thickness measurement specialists FISCHER, now present a new cavity probe which was designed to measure CDP-coatings in car body cavities.

This new magnetic-inductive probe V3FGA06H for the automotive industry, has a particularly slim and shaped handle with a small, hanging moveable probe head. It fits through the small openings available in each car body and can measure on paint layers inside cavities. The sophisticated design of the probe head enables the operator to take precise and repeatable thickness readings.

NEW: CAVITY PROBE *of Helmut Fischer, photo above with FMP 100 instrument.*

The new cavity probe V3FGA06H is fully compatible with the DELTASCOPE® and DUALSCOPE® hand-held coating thickness measurement instruments of the FMP- Series also available from Fischer Instrumentation (GB) Ltd.

For more information telephone 01590 684100 or email mail@fischergb.co.uk

Helmut Fischer sponsored his scientific library to the German Museum, Munich

Helmut Fischer, the founder of Helmut Fischer GmbH - a world leader in material testing, coating thickness and material analysis instrumentation - sponsored his valuable collection of old natural science books to the German Museum in Munich. The German Museum is the world's largest museum of technology and science. The sponsored 5000 books represent important publications about mathematics, physics and astronomy. Even early editions of Isaac Newtons "Principia mathematica" are included. A special exhibition shows the Fischer-collection from July to September 2011 at the German Museum.

Helmut Fischer talking to invited guests at the German Museum (Deutsches Museum)

Clock Tower of the German Museum (entrance for Fischer collection)

Fischer Report on the IMFair at the RAF Museum

In June, the Institute of Metal Finishing held its biannual IMFair 2011, a conference and exhibition for the aerospace and defence industries. This year it was held at the RAF Museum at Cosford.

The 3 day conference highlighted the trends in surface engineering in the aerospace and defence industries, and also showcased new products and processes in this industry sector.

As a sustaining member, Fischer Instrumentation exhibited at the event, with an XAN 120 X ray and a selection of hand held instruments and probes to demonstrate their capabilities to the attendees.

Materials Testing 2011, 13-15 September at the International Centre, Telford, United Kingdom

Fischer will be exhibiting at this comprehensive international exhibition of materials testing, non-destructive testing, condition monitoring and diagnostic engineering. If you would like to meet with Fischer at the exhibition, then please contact c.cave@fischergb.co.ukinstruments and probes to demonstrate their capabilities to the attendees.

X-ray XAN 120

Fischer's 3rd UK Seminar - November 2011

Following the success of two preceding seminars, Fischer plans to run a third during November 2011. The nature of the Seminar is that it is geared around the audience in attendance and is very practical, providing you with transferable skills and knowledge to use directly in the workplace or office. Fischer has a wealth of technical knowledge to share and the Seminars are proving to be the ideal forum for this. Fischer is also keen to receive feedback from its customers.

If you would like to attend or would like further information, please contact c.cave@fischergb.co.uk

Visit Fischer at Surface World, NEC, November 1-3 November, 2011

Fischer Instrumentation (GB) Ltd
Gordleton Industrial Park
Lymington Hampshire SO41 8JD
Tel: +44 (0)1590 684100
Email: mail@fischergb.co.uk Web: www.fischergb.co.uk