Advancing with Technology   **Elektro**Physik

Coating thickness measurement

MiniTest
4100 – 3100 – 2100 – 1100

Measurement of

- non-magnetic coatings (e.g. paint, zinc) on steel
- insulating coatings (e.g. paint, anodising coatings) on non-ferrous metals
- non-ferrous metal coatings on insulating substrates

Wear-resistant probes for multi-purpose use
High accuracy and reproducibility
Storage and documentation of readings

Coating thickness measurement with MiniTest

For more than 50 years now, ElektroPhysik has developed and produced an extensive range of precision measuring instruments for surface treatment. Being a pioneer in the field of non-destructive coating thickness measurement, ElektroPhysik in cooperation with national and international standardising bodies, research institutes and universities has successfully advanced the worldwide standardisation of coating thickness measurement. Numerous patents underline ElektroPhysik's position as a leading manufacturer.

MiniTest
4100 – 3100 – 2100 – 1100

Application

The MiniTest gauges are small universal gauges designed for non-destructive coating thickness measurement. For many years, automotive, shipbuilding, aircraft and machine manufacturers as well as government departments, inspectors, consultants and the paint and electroplating industry have used ElektroPhysik coating thickness gauges. Well-known automotive producers and leading manufacturers of nearly all branches of industry entrust ElektroPhysik gauges with their quality assurance.

Description

The MiniTest 4100 – 1100 series comprises four different basic gauges, thus offering different possibilities of processing of measuring values. Different probes are available which can be connected to all basic gauges. In order to select the "right" probe, the thickness of the coating to be measured as well as that of the substrate and the geometry have to be taken into consideration.

ElektroPhysik offers a range of probes suitable for standard as well as for special applications. For measurements on steel, the magnetic induction principle is used allowing measurement of all insulating coatings, e.g. paint, enamel etc., and non-ferrous metals on steel and ferrous metals. Probes working on the magnetic induction principle are referred to as F-probes.

For measurements of insulating coatings on non-ferrous metals, the eddy current principle is used. Probes working on this principle are referred to as N-probes.

DIN EN ISO 9000 ff./QS 9000/ISO/IEC 17025 (Guide 25)

Documentation and data analysis according to DIN EN ISO 9000 ff./QS 9000/ISO/IEC 17025 (Guide 25) requires to meet strictly defined rules and standards.

Therefore, when choosing a gauge for measuring coating thickness, in addition to evaluating the gauge's processing capabilities, consideration specifically to its high resolution and reproducibility capabilities should be focused on as well.

ElektroPhysik's MiniTest 3100 and 4100 coating thickness testing gauges provide both high resolution (up to 0.1 microns/0.01 mils in the 1...100 microns/0...10 mils thickness range), as well as application-oriented memory capabilities with comprehensive statistical calculations of a series of measurements.

The basic gauges offer different possibilities of data processing.

All basic gauges possess the following technical features:

- All probes can be connected
- RS 232 interface for portable data printer MiniPrint 4100 or PC
- Calibration with one or two foils

MiniTest 4100

MiniTest 4100 offers unique possibilities of data processing. In total, 10,000 measuring values can be stored in max. 99 application memories each with max. 98 batches. Application memories are extremely useful when different measuring tasks requiring different calibrations or probes occur regularly. The selected memory stores the calibration carried out and the probe used. Once MiniTest 4100 is prepared for various measuring tasks, taking a series of readings becomes simple and quick. Permanent calibration can be dispensed with and measuring errors are abolished.

For quality assessment, the stored measuring series can be evaluated according to the various statistics modes.

Setting limit values allows the user to take readings and at the same time monitor the tolerances specified for the production process. Acoustic signals indicate that a preset limit value was exceeded.

MiniTest 3100

MiniTest 3100 also possesses a total memory capacity of 10,000 readings and the possibility to store readings in 10 application memories with 10 batches each. A calibration once performed remains in the application memory. Statistical evaluation of a measuring series allows the user to assess the coating with mean value, max., min., standard deviation and number of readings taken within one measuring series.

MiniTest 2100

This gauge version also possesses a total memory capacity of 10,000 readings. A complete measuring series can be statistically evaluated. MiniTest 2100 is suitable for users with repeated applications, e. g. electroplated coatings on small objects. Switching off the gauge does not delete calibrations from the memory.

MiniTest 1100

This gauge is the basic version of the MiniTest 4100 series. Its functions are simple and clearly arranged. However, this low-cost version also works with all probes of the ElektroPhysik range. Thus, special applications, e. g. very thick coatings, can be measured at a reasonable price.
MiniTest 1100 does not offer either a memory or statistics.

Note

In order to help our customers to find the most suitable gauge model, an overview of all technical data is given on the last page.

The probe is the core component of the coating thickness gauge. In order to meet the various requirements of our customers, probes for the most common applications are part of our range of products. For extraordinary measuring tasks, customer-made probes are available.

ElektroPhysik probes are the result of a combination of modern production technologies as well as of a surface treatment know-how from more than 50 years.

Intelligent probes

ElektroPhysik has developed a concept of "intelligent probes" allowing working with another probe connected to the same gauge if the measuring task alters.

The characteristic curve of the probe is stored in the probe connector and evaluated by the gauge's micro-processor. It is thus possible to program characteristic curves specified to the customer's application, e.g. special alloys, special geometries etc.

Wearing protection

For the production of its probes, ElektroPhysik uses precision production procedures from the field of horology. To ensure a long life, the probes are protected through construction features, thus avoiding traces of wear even after years of use. The use of materials such as e.g. rubies, hard metal or special alloys used in tool manufacture protects the contacting measuring pole against wear. The surface of the measuring pole is polished, thus offering to measure even on sensitive measuring objects without leaving any traces.

Newly developed universal probes

Especially for users taking measurements on steel and on non-ferrous metals, ElektroPhysik offers newly developed FN-universal probes which solve both measuring tasks with only one probe.

Why is calibration necessary?

In order to adapt the probe to the individual measuring task in the best possible way, a calibration can be carried out. This calibration serves to compensate for influences exerted by the coating or the substrate as well as by the geometry of the object to be measured and improves the measuring accuracy.

Special features

When taking measurements on curved surfaces, the probe can be adapted to the geometry of the object to be measured by means of calibration. The influence of the geometry on the measuring values is thus eliminated.

When taking measurements on rough surfaces, a special feature of the MiniTest serves to compensate for the higher measuring uncertainty which is due to physical reasons.
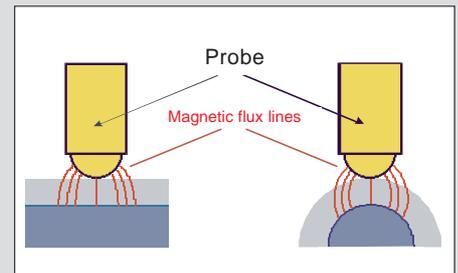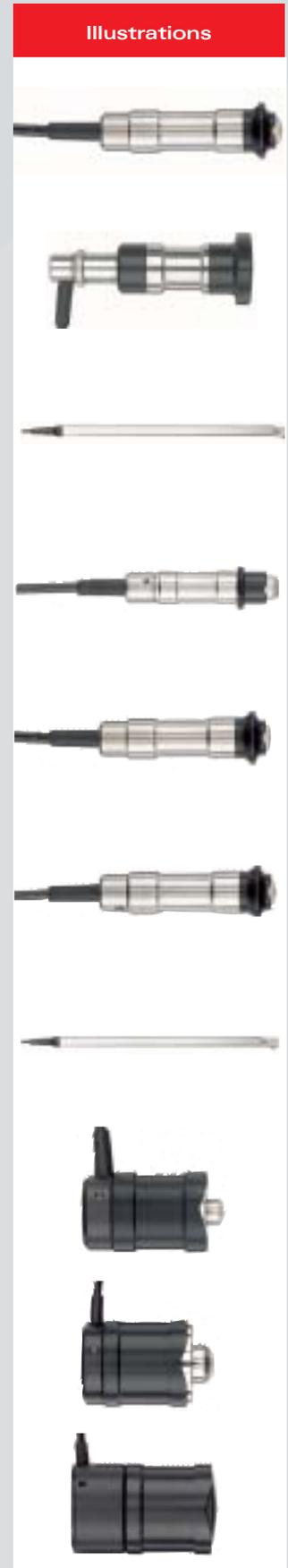

Magnetic flux lines on curved surfaces
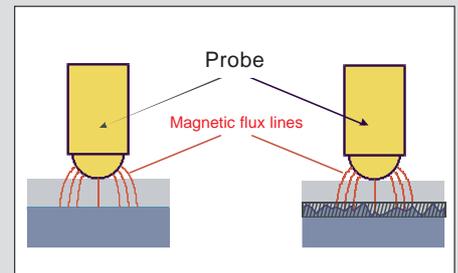
Magnetic flux lines on rough surfaces

For measurements on surfaces with high temperature, special probes are available which can briefly be used for temperatures up to 350°C.

MiniTest FN- and F-probes

Probe type	Measuring range/Minimum area for measurement	Application	Illustrations
FN 1.6	0...1600 μm Ø 5 mm	non-magnetic coatings on steel and insulating coatings on non-ferrous metal, high resolution (0.1 μm) in the lower part of the measuring range	
FN 1.6 P	0...1600 μm Ø 30 mm	powder coatings before baking on steel and non-ferrous metal	
FN 1.6/90 FN 2/90	0...1600 μm Ø 5 mm 0...2000 μm Ø 5 mm	non-magnetic coatings on steel and insulating coatings on non-ferrous metal, especially appropriate for measurements in tubes and pipes or objects which are difficult to access, high resolution (0.1 μm) in the lower part of the measuring range	
F 05	0...500 μm Ø 3 mm	extremely thin metal, oxide or paint coatings on small steel objects high resolution (0.1 μm) in the lower part of the measuring range	
F 1.6	0...1600 μm Ø 5 mm	non-magnetic coatings on steel high resolution (0.1 μm) in the lower part of the measuring range	
F 3	0...3000 μm Ø 5 mm	non-magnetic coatings on steel, thick paint and enamel coatings	
F 1.6/90 F 2/90	0...1600 μm Ø 5 mm 0...2000 μm Ø 5 mm	non-magnetic coatings on steel, especially appropriate for measurements in tubes and pipes or objects which are difficult to access; high resolution (0.1 μm) in the lower part of the measuring range	
F 10	0...10 mm Ø 20 mm	anticorrosive coatings in tanks and pipe construction, e. g. glass, plastics, rubber and concrete on steel	
F 20	0...20 mm Ø 40 mm	anticorrosive coatings in tanks and pipe construction, e. g. glass, plastics, rubber and concrete on steel	
F 50	0...50 mm Ø 300 mm	anticorrosive coatings in tanks and pipe construction, e. g. glass, plastics, rubber and concrete on steel, antinoise coatings	

MiniTest N- and CN-probes

Probe type	Measuring range/Minimum area for measurement	Application	Illustrations
N. 08CR	0...80 μm Ø 5 mm	extremely thin chrome coatings on copper	
N 02	0...200 μm Ø 2 mm	extremely thin insulating coatings, e.g. paint or anodising coatings on non-ferrous metal high resolution (0.1 μm) in the lower part of the measuring range	
N 1.6	0...1600 μm Ø 5 mm	thin insulating coatings, e.g. paint or anodising coatings on non-ferrous metal high resolution (0.1 μm) in the lower part of the measuring range	
N 1.6/90 N 2/90	0...1600 μm Ø 5 mm 0...2000 μm Ø 5 mm	thin insulating coatings, e.g. paint or anodising coatings on non-ferrous metal especially appropriate for measurements in tubes and pipes or objects which are difficult to access; high resolution (0.1 μm) in the lower part of the measuring range	
N 10	0...10 mm Ø 50 mm	insulating coatings, e.g. rubber, plastics, glass, on non-ferrous metal	
N 20	0...20 mm Ø 70 mm	insulating coatings, e.g. rubber, plastics, glass, on non-ferrous metal	
N 100	0...100 mm Ø 200 mm	insulating coatings, e.g. rubber, plastics, glass, compounds etc., on non-ferrous metal	
CN 02	10...200 μm Ø 7 mm	copper coatings on insulating substrates	
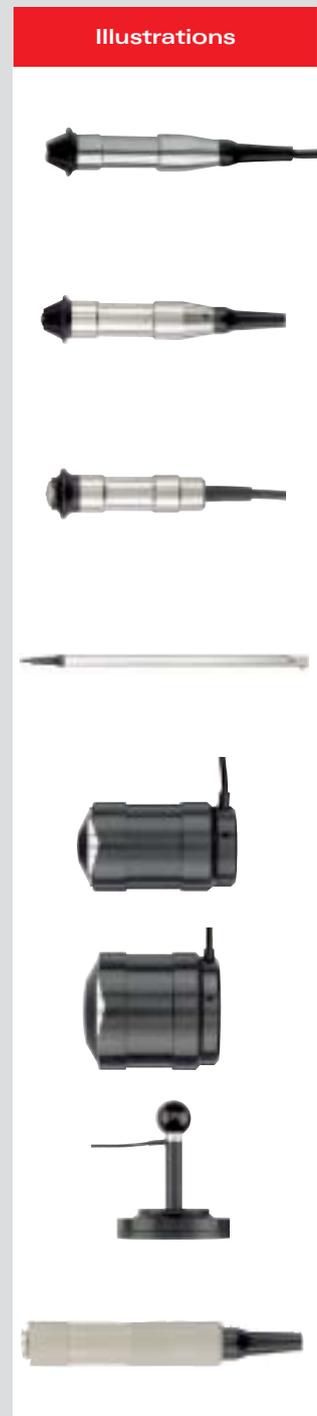
Accessories MiniTest

MiniPrint 4100 portable data printer, connected to the gauge without cable, for print-out of measuring values and statistics, with built-in accumulator battery and charger

Rubber case with mounting device to protect against mechanical shocks on-site

Belt case set – two cases of different size for gauge and accessories

Twin case for gauge and printer

PC evaluation program MSAVE for data transfer and MSOFT 41 for processing of measuring values, statistics and histograms

NiCd accumulator battery with charger 230 V

Precision support for measurements in production or on small parts

Calibration foils with thicknesses ranging from 10 μm up to 8 mm

Option: Manufacturer's certificates M according to DIN 55350 part 18 proving the accuracy of calibration foils and/or gauge

Technical data of probes

Principle	Probe		Measuring range	Low range resolution	Guaranteed tolerance (of reading)[1]	Minimum radius of curvature (convex/concave)	Minimum area for measurement	Minimum substrate thickness	Dimension in mm
Universal probes	FN 1.6		0...1600 µm	0.1 µm	± (1% + 1 µm)	1.5 mm / 10 mm	Ø 5 mm	F 0.5 mm / N 50 µm	Ø 15 x 62
	FN 1.6 P		0...1600 µm	0.1 µm	± (1% + 1 µm)	only on flat surfaces	Ø 30 mm	F 0.5 mm / N 50 µm	Ø 21 x 89
	FN 1.6/90	Internal pipe probe	0...1600 µm	0.1 µm	± (1% + 1 µm)	flat / 6 mm	Ø 5 mm	F 0.5 mm / N 50 µm	Ø 8 x 11 x 159
	FN 2/90	Internal pipe probe	0...2000 µm	0.2 µm	± (1% + 1 µm)	flat / 6 mm	Ø 5 mm	F 0.5 mm / N 50 µm	Ø 8 x 11 x 159
Magnetic induction	F 05		0...500 µm	0.1 µm	± (1% + 0.7 µm)	0.75 mm / 5 mm	Ø 3 mm	0.1 mm	Ø 12 x 49
	F 1.6		0...1600 µm	0.1 µm	± (1% + 1 µm)	1.5 mm / 10 mm	Ø 5 mm	0.5 mm	Ø 15 x 62
	F 3*		0...3000 µm	0.2 µm	± (1% + 1 µm)	1.5 mm / 10 mm	Ø 5 mm	0.5 mm	Ø 15 x 62
	F 1.6/90	Internal pipe probe	0...1600 µm	0.1 µm	± (1% + 1 µm)	flat / 6 mm	Ø 5 mm	0.5 mm	Ø 8 x 11 x 159
	F 2/90	Internal pipe probe	0...2000 µm	0.2 µm	± (1% + 1 µm)	flat / 6 mm	Ø 5 mm	0.5 mm	Ø 8 x 11 x 159
	F 10		0...10 mm	5 µm	± (1% + 10 µm)	5 mm / 16 mm	Ø 20 mm	1 mm	Ø 25 x 46
	F 20		0...20 mm	10 µm	± (1% + 10 µm)	10 mm / 30 mm	Ø 40 mm	2 mm	Ø 40 x 65
	F 50		0...50 mm	10 µm	± (3% + 50 µm)	50 mm / 200 mm	Ø 300 mm	2 mm	Ø 45 x 70
Eddy current principle	NO8 CR		0 ... 80 µm	0.1 µm	± (1% + 1 µm)	2.5 mm / 10 mm	Ø 5 mm	≥ 100 µm Cu	Ø 16 x 70
	N 02		0...200 µm	0.1 µm	± (1% + 0.5 µm)	1 mm / 5 mm	Ø 2 mm	50 µm	Ø 16 x 70
	N 1.6		0...1600 µm	0.1 µm	± (1% + 1 µm)	1.5 mm / 10 mm	Ø 5 mm	50 µm	Ø 15 x 62
	N 1.6/90	Internal pipe probe	0...1600 µm	0.1 µm	± (1% + 1 µm)	flat / 6 mm	Ø 5 mm	50 µm	Ø 8 x 11 x 159
	N 2/90	Internal pipe probe	0...2000 µm	0.2 µm	± (1% + 1 µm)	flat / 6 mm	Ø 5 mm	50 µm	Ø 8 x 11 x 159
	N 10		0...10 mm	10 µm	± (1% + 25 µm)	25 mm / 100 mm	Ø 50 mm	50 µm	Ø 60 x 50
	N 20		0...20 mm	10 µm	± (1% + 50 µm)	25 mm / 100 mm	Ø 70 mm	50 µm	Ø 65 x 75
	N 100		0...100 mm	100 µm	± (1% + 0.3 mm)	100 mm / flat	Ø 200 mm	50 µm	Ø 126 x 155
	CN 02 [2]	for Cu coatings on insulating substrates	10...200 µm	0.2 µm	± (3% + 1 µm)	only on flat surfaces	Ø 7 mm	at choice	Ø 17 x 80

Power supply: 1 x 9 V alkaline battery, AC adapter
Battery life: 10,000 measurements
Conforming standards: DIN 50 981, 50 982, 50 984, ISO 2178, 2360/BS 5411/ASTM B499, B244 - CE
[1] Relating to the supplied standards under laboratory conditions
[2] A different copper composition of our standards and the object to be measured requires a reference standard to be prepared (e.g. cross cut)

Ambient temperature:
Gauge: 0...50°C; Probe: –10°C...70°C, briefly 120°C
Dimensions/weight: 150 mm x 82 mm x 35 mm/270 g

*Probes for high temperatures up to 350°C available (measuring range 0 ... 2,000 µm)

Features of MiniTest

	1100	2100	3100	4100
MiniTest Memory capacity				
- Number of application memories		1	10	99
- Number of batches for each application memory		1	10	98
- Number of batches with individual value memories		1	max. 100	max. 500
- Total memory capacity for individual readings	1	10,000	10,000	10,000
MiniTest Statistics				
- From single values: $\bar{x}$, σ, kvar, n, max, min		●	●	●
- From single values: $\bar{x}$, σ, kvar, n, max, min, C_P, C_{PK}		●	●	●
- Block statistics: $\bar{\bar{x}}$, σ, kvar, n, max, min		●	●	●
- Block statistics: $\bar{\bar{x}}$, σ, kvar, n, max, min, C_P, C_{PK}			●	●
- From all subgroups (BATCH) in the same application (APPL)			●	●
- Print values and statistics separately to APPL-BATCH groups			●	●
- Display and print-out of date and time at the time of print-out and measurement (year, month, day, hour, minute)		●	●	●
MiniTest calibration methods				
- Calibration through a coating (CTC)		●	●	●
- Measurement on rough surfaces. The influence of roughness can nearly be eliminated	●	●	●	●
- OFFSET function adds or subtracts a constant value			●	●
- External function (trigger) to transfer readings to the memory	●	●	●	●
- Key lock to protect calibration	●	●	●	●
- Readings are saved during battery replacement	●	●	●	●
- Limit setting	●	●	●	●
- Measurements in microns or mils	●	●	●	●
- Continuous measuring mode with high speed readings to identify minimum and maximum values	●	●	●	●
- Selectable stabilising procedure in continuous mode for quick display (7 readings/s)	●			
- Data transfer with floating or fixed decimal point	●	●	●	●
- Reading of measuring values without probe being connected		●	●	●
- Later print-out of single values of one batch		●	●	●
- Display of minimum value in continuous mode	●	●	●	●

ElektroPhysik

925-A2 Specifications subject to change without notice