Operating Instructions
for
Elcometer 456

Basic Models

Ferrous, Non-Ferrous
and
Dual Ferrous/Non-Ferrous
Models
(F, N & FNF)

FNF UK Patent No: 2306009B
FNF US Patent No: 5886522

CE This product meets the emc directive 89/336/EEC, amended 92/31/EEC & 93/68/EEC

Warning

This instrument uses a Liquid Crystal Display. If it is heated above 50˚C (120˚F) it may be damaged. This can happen if it is left in a car parked in strong sunlight.

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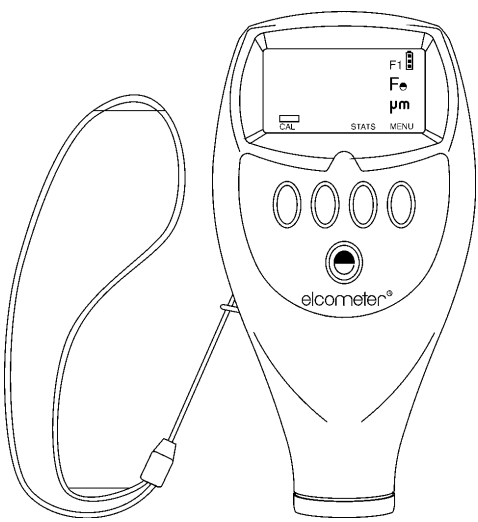
Elcometer 456
Basic Models

Contents



1 INTRODUCTION

The Elcometer 456 Coating Thickness Gauges have a full range of probe options for ferrous (F), non-ferrous (N) and dual ferrous/non-ferrous (FNF) operation.

The F probes measure the thickness of non-magnetic coatings on steel or iron substrates. They can be used on paint, plastic, galvanising, enamel, powder, hard chrome and other coatings such as electroless nickel.

The N probes are for measuring the thickness of non-magnetic coatings on non-magnetic metals. They can be used on anodising, paint, plastic coatings, powder, etc applied to aluminium, brass, non-magnetic stainless steel, etc.

The FNF probes are dual function with Automatic or Manual substrate selection.

The gauges are available as either integral probe or separate probe versions. All separate probes are fully interchangeable and there is a Plug IN Integral Probe (PINIP™) option so that an integral style probe can be pluged in to a separate probe type gauge.

Coatings on Galvanised or Metallised (Al and Zn) Steel Using the FNF

The FNF in fixed **N** mode may be used to measure paint coatings on galvanised, aluminium or zinc sprayed steel substrates. The instrument must be set to the **manual** mode before the **N** mode is selected. The unit should then be zeroed and calibrated on a sample of the coated steel. Care must be taken to ensure that the calibration conditions are not affected by changes in the zinc or aluminium coating thickness. This can be determined by checking the zero over an area of the galvanised or metal-coated steel. Metal coatings on steel above 50µm (2 mil/thou) should be consistent enough to obtain a stable zero on the layer of metal.

1.1 Features

The Elcometer 456 Basic versions have a graphics display, multiple calibration adjustment options, backlight and infrared data output.

For readings memory see the Standard and Top versions.

1.2 The Package contains

456 Gauge

456 Probe (Chosen from the list of options, including integral probes.)

Calibration Foils

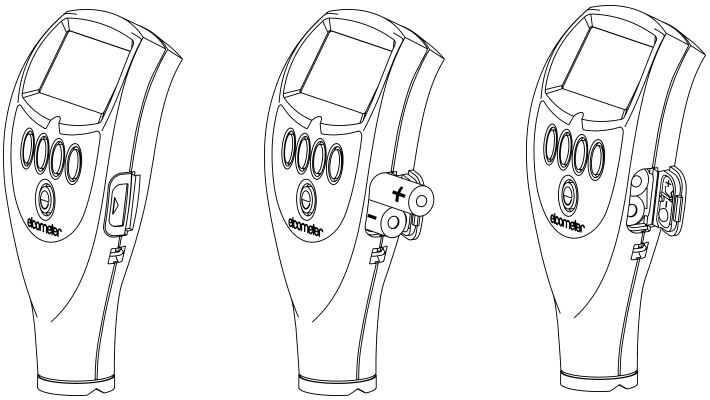
Carrying Pouch

Batteries

Operating Instruction Book

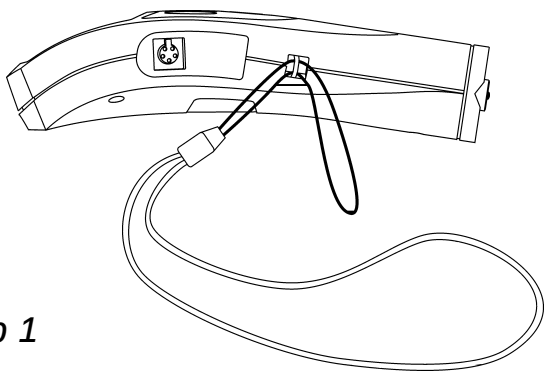
2 GETTING STARTED

2.1 Fitting The Batteries

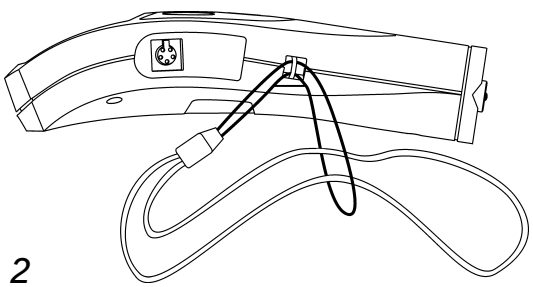


Use the thumb nail in recess to press the battery door toward back of the gauge to release. Note battery polarity. Rechargeable batteries can be used but they will only have 25–30% of the life of alkaline batteries.

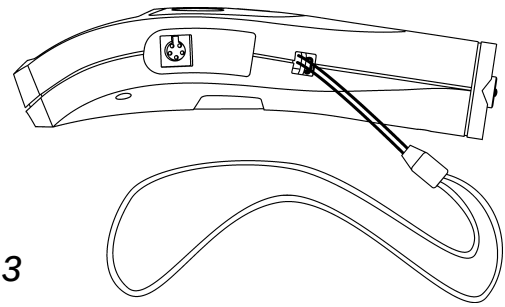
2.2 Fitting The Harness



Step 1

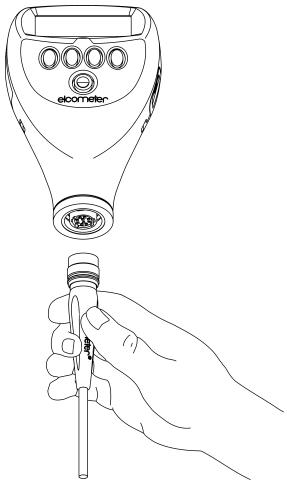


Step 2

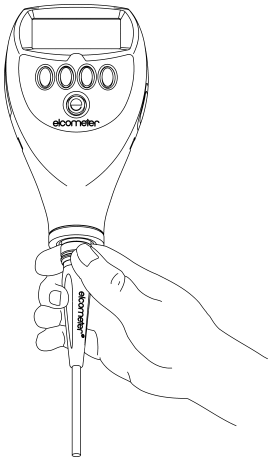


Step 3

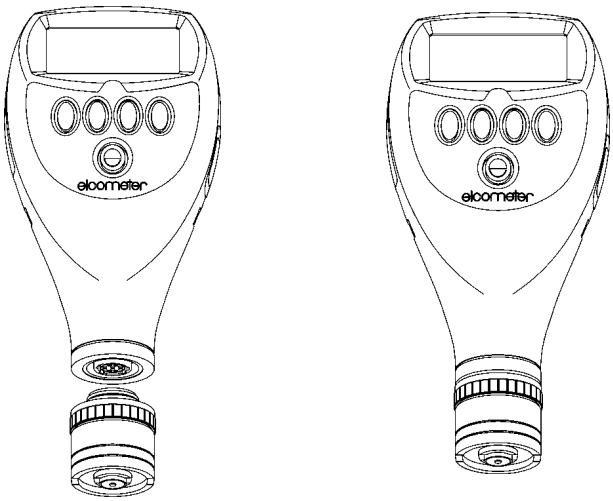
2.3 Fitting The Separate Probes



Align connector keyway and push home. The connector locks automatically.
NOTE: *<u>The design of the probe connector allows some movement between the probe and the gauge. This is intentional and does not affect measurement performance.</u>*



To release the probe, grasp the knurled section and pull gently away from the gauge. The connection will unlock and the probe will release.

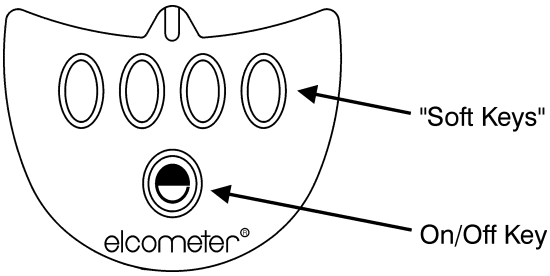


Fitting the PINIP™
Twist PINIP™ until the connector locates, then lock by turning the locking ring 1 1/2 times clockwise.

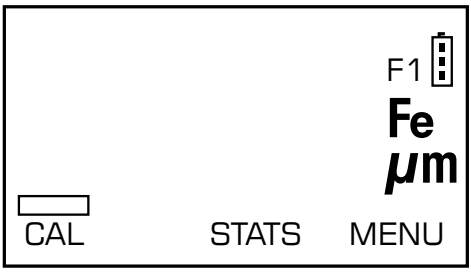
NOTE: *To ensure correct transfer of data from the probe and detection of a new probe, the gauge must be switched off when separate probes are fitted.*

2.4 Switch On

All versions of the Elcometer 456 can be switched on by pressing the keypad. Integral probe versions can also be switched on by placing the integral probe on a surface. (See Section 4.1)



2.4.1 Soft Keys

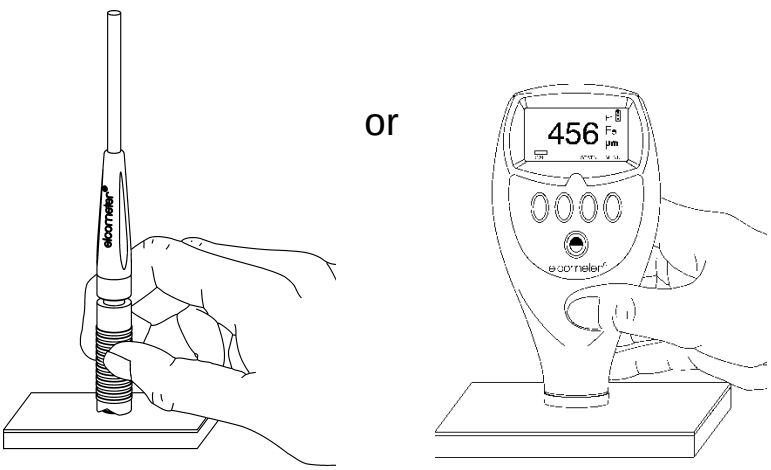


Softkey operations depend on the screen being viewed and are indicated on the screen as in the example above.

Some screens allow the status of a feature to be changed e.g. on to off or select or deselect, etc. A tick box indicates this type of feature. Use the **BACK** softkey to close the screen without a change or use the **SEL** softkey to change the status, tick off to on or tick on to off. See Section 3.3 for an example.

To return from any screen to the Reading screen press the **BACK** softkey until the Reading screen appears.

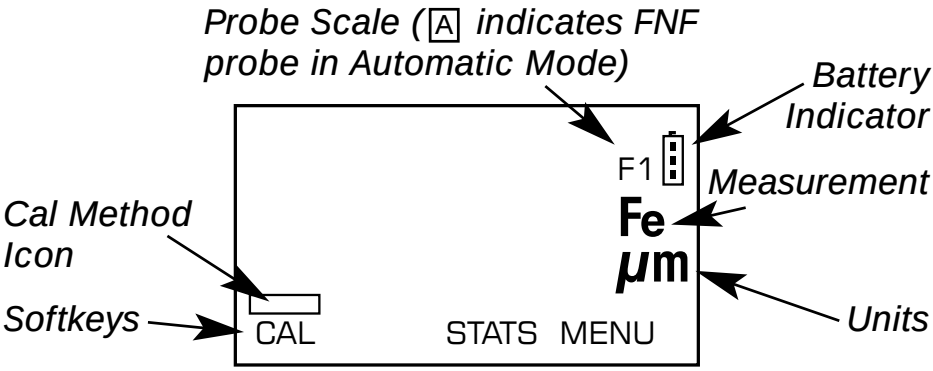
2.5 Taking a Reading



456 Separate and Integral Probe being placed on surface.

3 MENU STRUCTURE

3.1 Reading Screen Options



Example of Reading Screen with Smooth Surface Calibration Method Selected

CAL – Operates selected calibration adjustment method

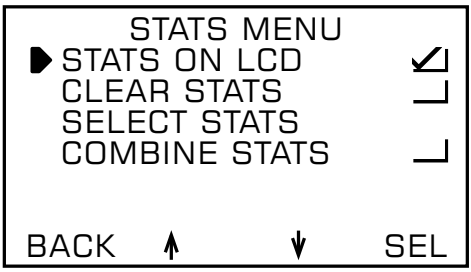
STATS – Clears Simple Statistics and switches statistics display on or off.

MENU – Main Menu for User selectable features

3.2 Calibration Adjustment Methods

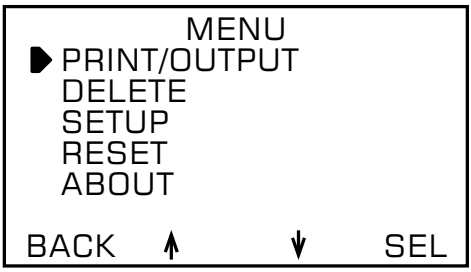
Example of Calibration Step 1 screen. The detail of this screen changes with the calibration method chosen.

3.3 Simple Statistics



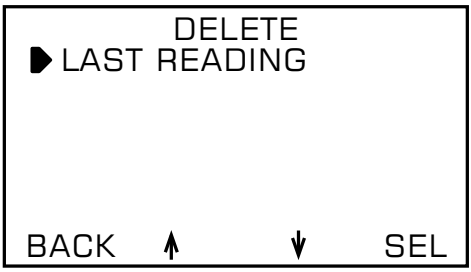
This menu shows the current selection status with a tick if selected or no tick if not selected. Press **BACK** softkey to leave status unchanged or press **SEL** softkey to change status.

3.4 Main Menu Options



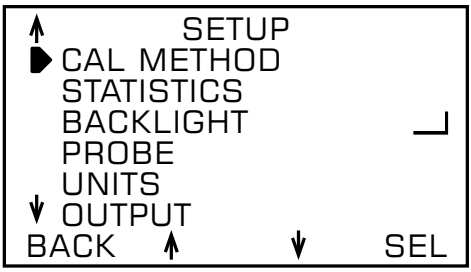
PRINT/OUTPUT – Prints or outputs the current statistics
DELETE – Last reading only
SETUP – Select features
RESET – Select Cal or Gauge resets
ABOUT – Select Probe or Gauge information

3.4.1 Delete Menu



LAST READING – Deletes last reading from the statistical calculation.

3.4.2 Setup Menu



CAL METHOD – Selects calibration method from list. See Section 5

STATISTICS – To select simple statistics to be displayed from list and combine statistics for Dual probes.

BACKLIGHT – Switches feature on or off. When switched on, the backlight illuminates the display for 4 seconds after each reading or key press. Use of the backlight reduces the battery life.

PROBE – Displays probe type in use and selects range on dual function probes, F1 2 or FNF1.

UNITS – Selects measurement units

OUTPUT – Select infrared printer output.

BEEP VOLUME – Switch bleep off or set level from 1 (low) to 5 (high).

LANGUAGE – Select from list.*

AUTO SWITCH-OFF – Select delay time or turn this feature off.

OPENING SCREEN – Turn this feature on or off.

* *See next page*

* To change language which is not understood:

Press left hand key until READING SCREEN is displayed.

Press right hand key once - displays MAIN MENU.

Press ↓ key (3rd from left) twice - moves cursor to SETUP selection.

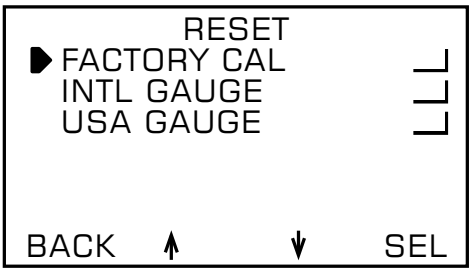
Press right hand key once - displays SETUP MENU.

Press ↓ key (3rd from left) 8 times - moves cursor to LANGUAGE selection.

Press right hand key once - displays language options.

Move cursor to recognised language, press right hand key to select.

3.4.3 Reset

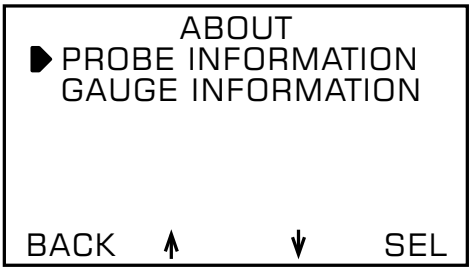


FACTORY CAL – Returns gauge to calibration adjustment set at time of manufacture.

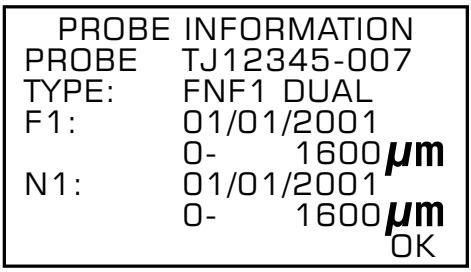
INTL GAUGE – Resets the gauge to International default settings eg. DD/MM/YY date format and metric units.

US GAUGE – Resets the gauge to USA default settings eg. MM/DD/YY date format and imperial units.

3.4.4 About

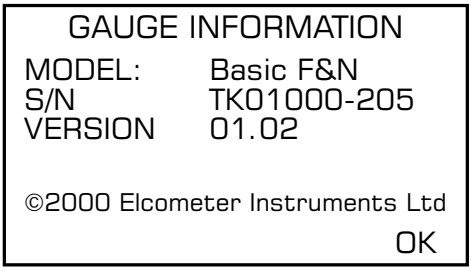


PROBE INFORMATION – Serial number, type and scale of probe connected to gauge.



Example for an FNF1 Probe

GAUGE INFORMATION

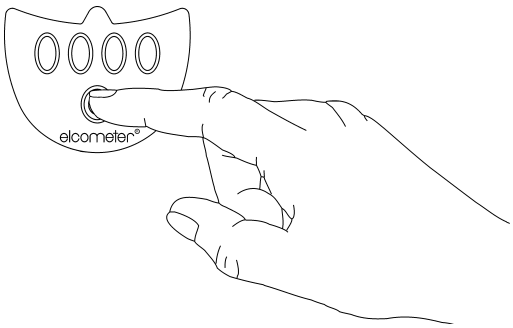


NOTE: The probe range shown on the Probe Information screen is the full operating range for the individual probe not the specified range for the probe type.

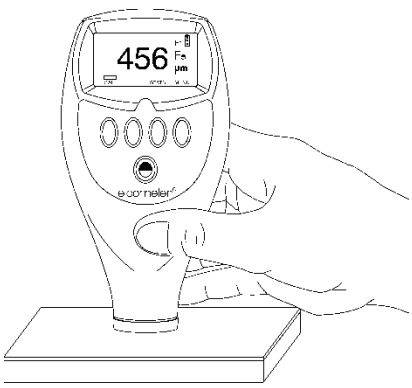
4 GENERAL OPERATING INSTRUCTIONS

4.1 Switch On/Switch Off

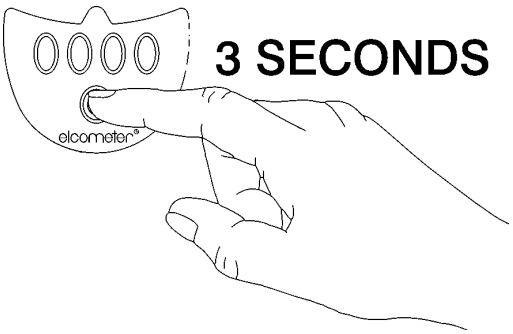
Gauges with Separate and PINIP probes are switched on or off by pressing .



Integral probe units switch on when the probe is placed on a surface.

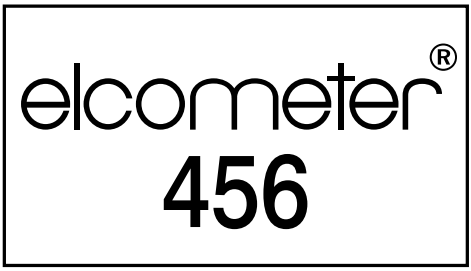


To switch off all gauge types, press and hold for 3 seconds. The gauge will bleep, two single tones followed by a double tone.

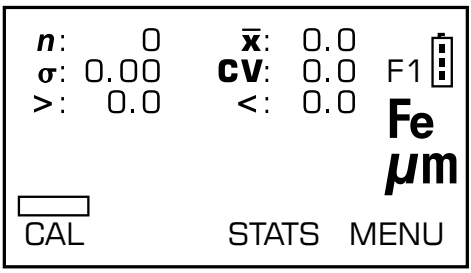


The Elcometer 456 switches itself off 60 seconds after the last operation unless the Auto Switch Off time is changed in the **SETUP** menu. The Auto Switch Off feature can be set to a maximum of 10 minutes or can be deactivated in the **SETUP** menu.

4.2 Opening Screen & Readings Screen



The opening screen can be deactivated in the **SETUP** menu. The gauge then wakes up showing the reading screen.



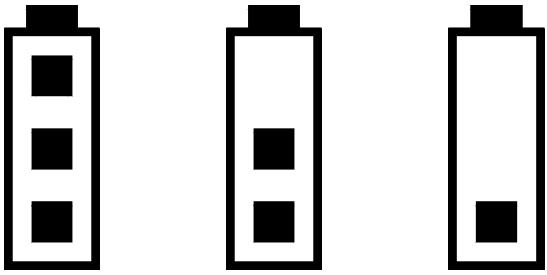
Reading Screen with all statistics activated.

NOTE: If CAL softkey indicator is flashing the gauge should be recalibrated. This is due to the calibration adjustment method having been changed or a probe change. See Section 5.3

4.3 Select Language

The most suitable language for the user can be selected within the Setup menu under the Language option. See section 3.4.2.

4.4 Battery Condition



When symbol is empty and is flashing a bleep will sound every 10 seconds to indicate that the battery should be changed.

If the battery charge drops below the acceptable level the gauge will bleep 5 times and switch itself off.

NOTE: *Batteries in this condition must be changed to operate the gauge*.

4.5 Probe Mode Selection

The Probe options found in the Setup menu will depend on the probe type in use.

The intelligent probe also selects the units eg. µm or mm and mil, thou or in, until the user changes the units in the **SETUP**, **UNITS** menu.

4.5.1 F1 2 Scale Selection

The F1 2 probe has two range and resolution selections in the **SETUP** menu under the **PROBE** option.

F1

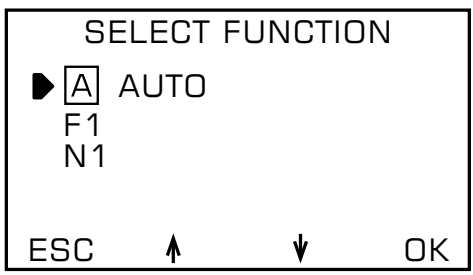
METRIC RANGE	0–1,500µm with resolution 0.1µm up to 20µm and 1µm from 20µm to 1,500µm.
IMPERIAL RANGE	0–60 mil with resolution 0.01 mil to 1 mil and 0.1 mil from 1 mil to 60 mil

F2

METRIC RANGE	0–5.00mm with resolution of 1µm (0.001mm) to 1.00mm and 10µm (0.01mm) from 1.00mm to 5.00mm
IMPERIAL RANGE	0–200 mil with resolution of 0.1 to 50 mil and 1.0 mil from 50 to 200 mil

4.5.2 FNF Mode Selection

Select the mode in the **SETUP** menu under the **PROBE** option.



Manual Mode. For use when only one type of substrate is being used, F or N.

WARNING

Do not try to take readings on a ferrous (F) substrate when in the N manual mode. The readings will be incorrect.

Automatic Mode. The gauge automatically selects either F or N depending on the substrate. F or N is shown on the display.

4.6 Units

Select from µm, mm, mil, thou or in.

4.7 Backlight

When activated the backlight illuminates the display for 4 seconds after a reading is taken or a key is pressed. Backlight is controlled through the **BACKLIGHT** option in the **SETUP** menu.

NOTE: The battery life is reduced by about 1/3rd when the backlight is activated.

5 CALIBRATION ADJUSTMENT

5.1 Factory Calibration

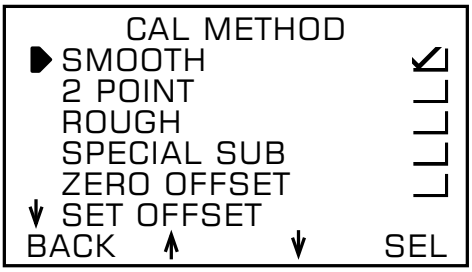
The gauge is dispatched from the factory with a pre-set (factory) calibration. This can be restored at any time through the **RESET** menu in **SETUP**.

The Elcometer 456 should be adjusted before use or at least checked to ensure that it has been previously adjusted correctly for the conditions of use.

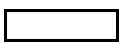
5.2 Calibration Method

The User is guided through the operation of the chosen calibration procedure by means of instructions and illustrations on the graphics screen. Audible warnings are also provided when action is required, e.g. when the probe must be placed down to get a reading.

The gauge can be adjusted using several different methods described in National and International Standards.



The calibration adjustment method chosen is indicated on the reading screen by one of the following icons:

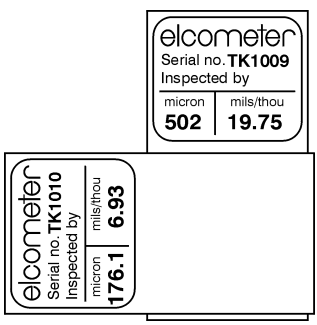
	=	Smooth surface calibration
	=	Rough surface calibration
2 pnt	=	Two point calibration
	=	Zero offset calibration
Sp	=	Special substrate calibration method (2-point calibration)

5.3 Calibration Adjustment

Calibration adjustment should be carried out with the appropriate probe on the same type of metal, the same curvature and similar finish to the item to be measured. It is best to use an uncoated sample of the items to be tested.

Calibration can be carried out using measured foils or coated standards. The use of coated standards only confirms that the gauge meets its specifications. When using foils care must be taken to keep the foils clean and free from dust and to avoid damage by creasing particularly the lower value foils.

NOTE: To calibrate 5mm (200 mils) and 13mm (500 mils) range gauges it will be necessary to stack the foils. Care must also be taken to avoid errors due to placing the foil labels between the foils.



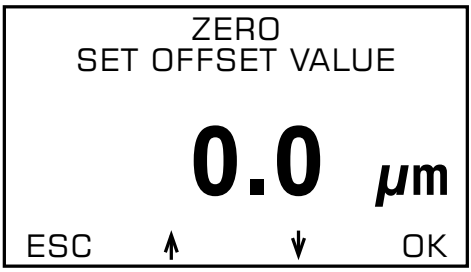
SMOOTH – Smooth surface calibration where the gauge is set to zero on the uncoated surface and a known thickness above the expected thickness of the coating.

2-POINT – Calibration on a thin value and a thick value either side of the expected thickness. This will enhance the accuracy of the gauge over the thickness range defined by the two values. This method is also called Rough Surface Calibration.

SPECIAL SUB – This method uses the 2-point calibration for unusual substrate materials such as cast iron, certain types of stainless steel, high carbon steel, special aluminium alloys, etc.

ZERO OFFSET – This is the method described in BS EN ISO 19840 for coatings on steel surfaces roughened by blast cleaning. The calibration uses the smooth surface technique and a correction value (zero offset) is applied to each reading to account for the effect of the roughened surface.

SET OFFSET – This screen sets and changes the offset for different surface roughness.

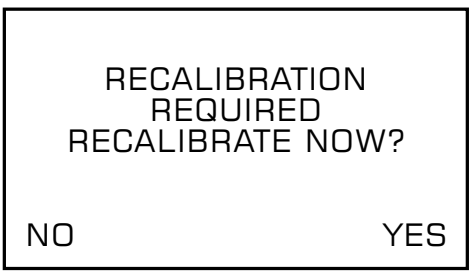


Correction Value Table

Profile according to ISO 8503-1	Correction Value µm (Zero Offset)
Fine	10
Medium	25
Coarse	40

Correction Values as detailed in BS EN ISO 19840

NOTE: When the calibration method is changed, eg. from Smooth to Rough, the gauge will display a message as follows:



If the "**NO**" key is pressed the **CAL** softkey indicator on the Readings display will flash to warn that calibration adjustment is still required.

If the "**YES**" key is pressed the calibration adjustment routine is activated.

5.4 Calibration Adjustment Screens

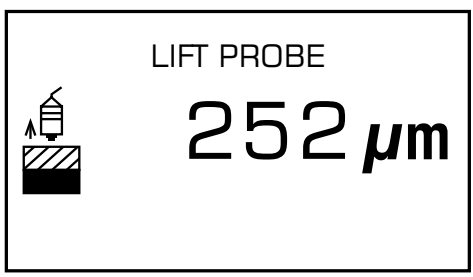
The calibration adjustment can be carried out at any time by selecting **CAL** from the reading screen. The routine is described on the graphics screen with words and diagrams. If the routine is interrupted in any way the previous settings will be restored until the full calibration routine has been completed or the reset has been completed.

The screen detail depends on the calibration method chosen but the calibration is in two steps:

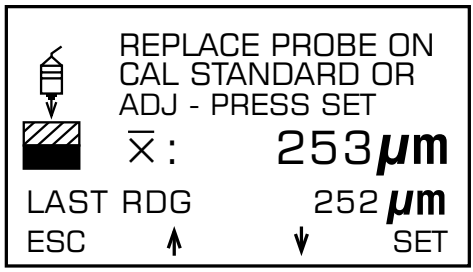
Step 1 Place the probe on a calibration standard and lift the probe. Repeating the reading will display the average ($\bar{x}$) and the last reading. The displayed reading value can be adjusted with ↓ or ↑ keys until it is correct.

Press set to enter the value.

(**NOTE:** **– – –** indicates over range)



1st reading

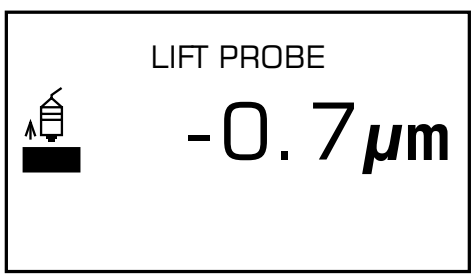


2nd and subsequent readings

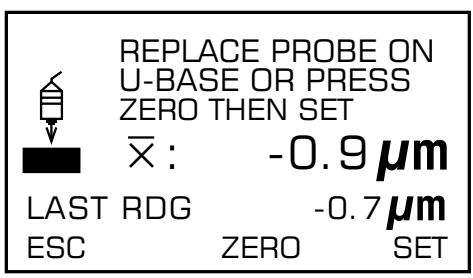
Step 2 Place the probe on an uncoated standard (smooth calibration) or a thin calibration standard (2-point, rough, special substrate etc.). Repeating the reading will display the average ($\bar{x}$) and the last reading. The displayed reading can be adjusted with the softkeys.

Press **SET** to enter the value.

NOTE: Pressing NEXT will skip Step 1 or Step 2. Pressing ESC will return to the readings display with the calibration unchanged.



1st reading



2nd and subsequent readings

6 DATA OUTPUT

A statistical summary can be output via the infrared interface to a suitable printer.

The Elcometer 456 Basic version is fitted with an InfraRed printer output port and is programmed to work with the Hewlett Packard (HP) InfraRed Portable Printer.

Other InfraRed printers with different print protocols may not be supported. Consult your local dealer.

The Elcometer 456 Basic sends the current statistical summary when operated from the **MENU**, **PRINT/ OUTPUT** option.

7 SERVICE

You own probably the finest hand-held coating thickness gauge in the world today. If looked after, it will last a lifetime.

Regular calibration checks over the life of the gauge and its probe are a requirement of quality management procedures, e.g. ISO 9000 and other quality standards. For gauge checks and certification contact your local Elcometer dealer.

In the unlikely event of a fault the gauge should be returned to your local Elcometer dealer, directly to Elcometer Instruments Ltd. or contact us for advice at:

e-mail: sales@elcometer.com
or service@elcometer.com

Web: www.elcometer.com

Tel: +44 (0)161 371 6000

Fax: +44 (0)161 371 6010

NOTE: Probes will eventually wear. Probe life will depend on the number of measurements taken and how abrasive the coating is. Replacement separate and PINIP probes can be fitted by the User without the need to return the gauge for service.

Integral probe gauges have to be returned for reprogramming or replacement if worn or damaged.

8 ERROR MESSAGES

Under certain conditions the gauge will display error messages. These messages are normally cleared by pressing any one of the softkeys. The error message will contain an indication of the cause which should be corrected before proceeding.

9 TECHNICAL DATA

Scale Ranges: Probe Options

The F1 2 scale combines the F1 scale with the F2 scale in a single probe with the user selecting the appropriate range for the work in hand. The resolution of the gauge is dependent on the scale selected on the gauge.

Integral Probe Options

456F, 456N & 456FNF F1, F1 2, F3, N1 & FNF1 Scales

Separate Probe Options

456F, 456N, & 456FNF (F1, F1 2, F3, N1, N1A & FNF1 Scales)

Right Angle Separate Probes are available for F1, F1 2, N1 and FNF1 Scales

A Telescopic Separate Probe is available for the F1 and F1 2 Scales.

An Anodiser's Probe is available for the N1 Scale.

Integral Probe Options

PINIP Probes (Plug IN Integral Probe) are available in place of Separate probes with cables for F1, F1 2, F3, N1 and FNF1 Scales.

National and International Standards:
The Elcometer 456 can be used in accordance with:

Ferrous (F)	Non-Ferrous (NF)
BS 5411 (11)	BS 5411 (3)
BS 3900 (C5)	BS 3900 (C5)
ISO 2178	ISO 2360
ISO 2808	ISO 2808
BS EN ISO 1461	DIN 50984
DIN 50981	ASTM D 1400
ASTM B 499	
ASTM D1186	
BS EN ISO 19840	
SSPC-PA2	

Display:
Full Graphics Liquid Crystal Display (Graphics LCD), 128 x 64 pixels
Active Display Area: 19.8 x 39.6mm (0.78” x 1.56”)

Operating Temperature:
0–50˚C; 32–120˚F

Dimensions:
130 x 70 x 35mm (5.12” x 2.76” x 1.38”)

Weight (with batteries fitted):

456 Separate Probe (FNF1)	190g (6.7oz)
456 Separate Probe (PINIP)	155g (5.5oz)
456 Integral Probe	130g (4.6oz)

Measurement Speed:
>60 readings per minute.

NOTE: This rate is reduced to >40 readings per minute when the InfraRed (IR) data output feature is operating.

Battery Type:
2 x LR03 (AAA)

Rechargeable batteries can be used. They have to be charged outside the gauge. Battery life is reduced to

approximately 25% of the dry battery life when using rechargeable batteries. Follow the battery manufacturer's instructions when charging and disposing of rechargeable batteries.

Do not dispose of in fire.

Battery Life:
30–40 hours continuous use with alkaline dry batteries. (15,000–20,000 readings at an average of 8 readings per minute.) Battery life is reduced by 1/3rd when using the backlight.

Minimum Substrate Thickness:
300µm (12 mil) unless special adjustment is made. Gauges will have reduced range when adjusted for thin substrates.

Measurement Performance:

Scale F1, F2 and F1 2		
Range	**Accuracy[1]**	**Resolution**
(F1) 0–1,500µm (F1 2 when set for F1 operation)	±3% or ±2.5µm ±1% or ±2.5µm[2]	below 100µm, 0.1µm above 100µm, 1µm to 1,5000µm
(F2) 0–5.00mm (F1 2 when set for F2 operation)	±3% or ±20µm ±1% or ±20µm[2]	below 1000µm (1mm) 0.1µm, above 1000µm (1mm) 10µm to 5mm
(F1) 0–60 mil	±3% or ±0.1 mil ±1% or ±0.1 mil[2]	below 5 mil, 0.01 mil above 5 mil, 0.1 mil to 60 mil
(F1 2) 0.5–200 mil	±3% or ±1 mil ±1% or ±1 mil[2]	below 50 mil, 0.1 mil above 50 mil, 1 mil

[1]Whichever is the greater

[2]When calibrated close to the thickness to be measured.

Scale F3		
Range	**Accuracy[1]**	**Resolution**
0–13mm	±3% or ±0.05mm ±2% or ±0.05mm[2]	below 2mm, 1µm above 2mm, 10µm
0–500 mil	±3% or ±2 mil ±2% or ±2 mil[2]	below 100mil, 0.1mil above 100mil, 1mil

Scale N1, N1A, FNF1		
Range	**Accuracy[1]**	**Resolution**
0–1,500µm	±3% or ±2.5µm ±1% or ±2.5µm[2]	below 100µm, 0.1µm above 100µm, 1µm to 1,500µm
0–60 mil	±3% or ±0.1 mil ±1% or ±0.1 mil[2]	below 5mil, 0.01mil above 5mil, 1mil

[1]Whichever is the greater

[2]When calibrated close to the thickness to be measured.

Probe Capabilities:

Probe Type	Minimum Convex Surface Diameter	Minimum Concave Surface Radius	Headroom	Minimum Sample Diameter	Cal Foil Value[1]
Separate Ferrous					
F1 (or F1 2 set for F1 operation)	4mm (0.16”)	25mm (0.98”)	85mm (3.35”)	4mm (0.16”)	250µm (10mil)
F2 (or F1 2 set for F2 operation)	4mm (0.16”)	25mm (0.98”)	85mm (3.35”)	4mm (0.16”)	1mm (40mil)
F1 Right Angle	4mm (0.16”)	25mm (0.98”)	25mm (0.98”)	4mm (0.16”)	250µm (10mil)
F1 2 Right Angle	4mm (0.16”)	25mm (0.98”)	25mm (0.98”)	4mm (0.16”)	1mm (40mil)
F1 Telescopic	4mm (0.16”)	25mm (0.98”)	30mm (1.18”)	4mm (0.16”)	250µm (10mil)
F1 2 Telescopic	4mm (0.16”)	25mm (0.98”)	30mm (1.18”)	4mm (0.16”)	1mm (40mil)
F3	15mm (0.59”)	40mm (1.57”)	85mm (3.35”)	22mm (0.87”)	2.5mm 100mil)
Separate Non-Ferrous					
N1	22mm (0.87”)	25mm (0.98”)	90mm (3.54”)	10mm (0.39”)	250µm (10mil)
N1 Right Angle	22mm (0.87”)	25mm (0.98”)	25mm (0.98”)	10mm (0.39”)	250µm (10mil)
N1A Anodiser’s Probe	TBA				

[1]This is the recommended maximum calibration foil value to achieve the specified accuracy under these measurement conditions.

Probe Capabilities:

Probe Type	Minimum Convex Surface Diameter	Minimum Concave Surface Radius	Headroom	Minimum Sample Diameter	Cal Foil Value[1]
Separate Dual FNF					
FNF1 (N)	44mm (1.73”)	50mm (1.96”)	90mm (3.54”)	18mm (0.71”)	250µm (10mil)
FNF1 (F)	8mm (0.31”)	50mm (1.96”)	90mm (3.54”)	8mm (0.31”)	250µm (10mil)
FNF1 Right Angle (N)	44mm (1.73")	50mm (1.96”)	25mm (0.96")	18mm (0.71")	250µm (10mil)
FNF1 Right Angle (F)	8mm (0.31")	50mm (1.96”)	25mm (0.96")	8mm (0.31")	250µm (10mil)
Integral					
F1 (or F1 2 set for F1 operation)	4mm (0.16”)	25mm (0.98”)	130mm (5.1”)	4mm (0.16”)	250µm (10mil)
F2 (or F1 2 set for F2 operation)	4mm (0.16”)	25mm (0.98”)	135mm (5.3”)	4mm (0.16”)	1mm (40mil)
F3	TBA				
N1 (N)	22mm (0.87”)	25mm (0.98”)	130mm (5.1”)	10mm (0.39”)	250µm (10mil)
FNF1 (N)	44mm (1.73”)	50mm (1.96”)	135mm (5.3”)	18mm (0.70”)	250µm (10mil)
FNF1 (F)	8mm (0.31”)	50mm (1.96”)	135mm (5.3”)	8mm (0.31”)	250µm (10mil)

[1]This is the recommended maximum calibration foil value to achieve the specified accuracy under these measurement conditions.

Probe Capabilities:

Probe Type	Minimum Convex Surface Diameter	Minimum Concave Surface Radius	Headroom	Minimum Sample Diameter	Cal Foil Value[1]
PIN1P					
F1 (or F1 2 set for F1 operation)	4mm (0.16”)	25mm (0.98”)	155mm (6.1”)	4mm (0.16”)	250µm (10mil)
F2 (or F1 2 set for F2 operation)	4mm (0.16”)	25mm (0.98”)	160mm (6.3”)	4mm (0.16”)	1mm (40mil)
F3	TBA				
N1	22mm (0.87”)	25mm (0.98”)	160mm (6.3”)	10mm (0.39”)	250µm (10mil)
FNF1 (N)	44mm (1.73”)	50mm (1.96”)	165mm (6.5”)	18mm (0.70”)	250µm (10mil)
FNF1 (F)	8mm (0.31”)	50mm (1.96”)	165mm (6.5”)	8mm (0.31”)	250µm (10mil)

[1]This is the recommended maximum calibration foil value to achieve the specified accuracy under these measurement conditions.

10 ACCESSORIES

Some of the following items are optional. However, some are consumable items that may need to be replaced over the lifetime of the gauge.

Dry Batteries:

T4569329-	2 off Alkaline Cells (AAA)

Foil Sets:

T9904199F	1mm (40 mil) 8 pieces
T9904199G	1mm (40 mil) 3 pieces
T9904199J	5mm (200 mil) 4 pieces
T9904199K	13mm (500 mil) 4 pieces
T9904199N	1.5mm (60 mIl) 3 pieces

Individual foils in the range 12.5µm (0.5 mil) to 8mm (315 mil) and customised sets chosen from this range are also available. Consult your local Elcometer Dealer.

Calibration Certificates:

Certificates traceable to National Standards including UKAS and NIST are available on request.

Test Certificates:

A certificate with results of a standard test on known foil values over the full range of the probe. Order using Part No. TEST-456

Coated Thickness Standards including Certificate

T995111261	Ferrous Standard (4 Values)
T999111271	Non-Ferrous Standard (4 Values)
T995 TBA	Ferrous Standard (2 Values)
T995 TBA	Non-Ferrous Standard (2 Values)

Probe Positioning Jig

T95012880

Probe Adapters: (Standard F & N Probes Only)

T4567766-	Jumbo Hand Grip
T4567381-	V Adapter (for pipes)

Printer Lead:

T45616267	456 to Printer Connection Cable (25-pin)

Printers:

INFRARED PORTABLE PRINTER

X45613877	Hewlett Packard (HP) Infrared Portable Printer
T45613878	HP Thermal Printer Paper

MINIPRINTER

42 column, rechargeable battery powered Miniprinter complete with cable in three charger options

X4569964B	230V (UK Plug)
X4569964C	230V (European Plug)
X4569964D	110V (US Plug)

MINIPRINTER SPARES

T45616267	456 to printer connection lead
T9769992-	Ribbon Cassettes (Pack of 5)
T9769993-	Paper Rolls (Box of 20)

Bench Stands

T45616161	Integral Probe Version
T45616162	Integral/Separate Probe Version

PC Lead

T45616217	456 to PC Connection Lead (9-pin)

NOTE: A 9-pin to 25-pin adapter may be required for certain PC RS232 ports.

11 GLOSSARY

About: Information screens for probe and gauge within the Main menu.

Auto Batching: Memory for readings with the batch number automatically determined by the gauge. *(Top only)*

Automatic Mode: Setting for Dual FNF probe so that the substrate type is determined automatically.

Average Mode: A data collection method where the user determines the subgroup size. *(Standard and Top only)*

Back: Softkey control that returns gauge to the previous screen without any change to settings.

Backlight: Illumination for the display that can be switched on or off by the user.

Basic: One of the three feature versions of the gauge with simple statistics but no memory for readings.

Batching: Collection of reading data in groups to allow easier analysis of large structures or complex assemblies. *(Standard and Top only)*

Calibration Adjustment: Setting the gauge to known values of thickness to ensure accuracy on different substrate types, shapes and surface finishes.

Calibration Foils: Coating thickness standards measured using techniques independent of the gauge for setting known values of thickness on the substrate to be measured.

Calibration Method: Adjustment technique for the gauge dependant on the condition of the substrate to be measured, e.g. smooth surface calibration, rough surface calibration, etc.

Coated Standards: Thickness standards using typical substrate materials coated with hardwearing materials and measured using techniques independent of the gauge.

Coefficient of Variation: The standard deviation divided by the mean for a group of readings, expressed as a percentage.

Combined Statistics: FNF operation statistics are kept separately for F and N readings unless the combined statistics is activated, also applies to F1 2 operation.

Counted Average Mode: A data collection method using a pre-set number of readings for each sub-group. The gauge records the average of the group as a single value, e.g. for a counted average set to three readings, the gauge records the average of each group of three readings in turn. *(Standard and Top only)*

Current Batch: The active batch when data is being collected.

Current Statistics: The statistical values for the active batch.

Delete: Cancellation of an individual reading, a batch of readings or the whole memory of readings and statistical data.

EDCS: The Windows® based Elcometer Data Collection software also available as EDCS+. *(Standard and Top only)*

EDTS: A data transfer software for uploading readings from the memory of a gauge to a spreadsheet, also known as EDTS Excel® Link. *(Standard and Top only)*

Error Message: Text message displayed on the LCD screen when an operational error has been detected, e.g. gauge switched on with no probe connected, print function selected with no connection to the printer. Pressing any of the four softkeys normally clears these messages.

ESC: Abbreviation for escape. This softkey control returns the gauge to the Reading Screen from the Calibration Procedure without making any changes.

F: Abbreviation for Ferrous substrate, i.e. a magnetic metal onto which a coating is applied.

Factory Calibration: Calibration values set when the probe is manufactured. These settings can be recalled by the User in the RESET menu. **NOTE:** *FACTORY CALIBRATION will not necessarily restore precise calibration values. So calibration adjustment is recommended after FACTORY CALIBRATION is implemented.*

Ferrous: The measurement method applicable to coatings on magnetic metals such as steel, cast iron, etc. The Elcometer 456 uses the electromagnetic induction principle to determine the coating thickness on Ferrous substrates.

FNF: Abbreviation for the dual Ferrous/Non-Ferrous probe option.

Highest Reading: The value for the greatest thickness in a group of readings.

Integral Probe: The probe option where the probe is fixed to the case of the gauge without any external cable. Appropriate for one handed operation of the gauge.

International Gauge Setting: Default settings for the gauge for all areas except the USA. Sets the units to metric, the calendar to DD/MM/YY format and all other settings to the default condition.

Limits: Upper and lower values that can be set by the user to monitor specification values. *(Standard and Top only)*

Lowest Reading: The value for the least thickness in a group of readings.

Manual Mode: The setting for the dual function FNF probe that makes the probe function as either an F only or a N only probe, as opposed to the automatic mode.

Mean: The average of a group of readings, the sum of the individual readings divided by the number of readings.

Memory: The feature of the Elcometer 456 Standard and Top options that allows individual readings to be stored for recording and/or analysis.

Menu Operation: The Elcometer 456 operates using user-selected options from a series of menus. The graphical display allows text and images to be displayed to aid operation of the various gauge procedures and features.

N: Abbreviation for Non-Ferrous substrate, i.e. non-magnetic metals to which a non-conductive coating is applied.

Non-Ferrous: The measurement method applicable to coatings on non-magnetic metals such as aluminium, copper, some types of stainless steel, etc. The Elcometer 456 uses the eddy current principle to determine the coating thickness on Non-Ferrous substrates

Normal Mode: A data collection method where the gauge records individual readings. *(Standard and Top only)*

Number of Readings: The running value for the number of readings taken in a group. In the case of the averaging or counted average, the Number of Readings is the number of values recorded not the total number of readings taken.

Opening Screen: The screen that is displayed when the gauge is switched on. This screen can be switched off under user control.

Output: The data stream from the memory of the gauge sent via the data port to a computer or a suitable printer. *(Standard and Top only)*

PINIP: The Plug IN Integral Probe option for the separate probe gauge types. This is a separate probe option without the cable and therefore allows one-handed operation.

Print: The formatted data output suitable for serial printers and includes headers and space for written user notes. *(Standard and Top only)*

Recalibration: Readjustment of the gauge settings for zero and/or known values of thickness using calibration foils or coated standards.

Reset: The ability to return the gauge to default settings for the operational features, an option on the Main Menu.

Reading Screen: The screen where readings are displayed. This screen can include statistics if selected and batch information if in use.

SEL: Abbreviation for Select. This softkey control selects the option displayed. In some cases pressing SEL puts a tick in to the tick box to indicate that the feature is selected, e.g. Backlight on.

Separate Probe: The probe option where the probe is attached to the gauge via a cable and connector. These probes are interchangeable and allow maximum flexibility of operation and access.

Setup: The ability to select and/or adjust the gauge features via the menus. Features in the Setup menu are Calibration Method, Statistics, Backlight, Probe, Units, Output, Beep Volume, Language, Auto Switch Off and Opening Screen.

Softkeys: The flexible control feature that allows the four controls to vary their function depending on the location in the gauge software. Each screen has its own set of control functions.

Software: Elcometer support for gauges with RS232 output, see EDCS and EDTS. *(Standard and Top only)*

Standard: One of the three feature versions of the gauge with a single batch memory for upto 250 readings.

Standard Deviation: A statistical measure of the spread of values in a group of readings.

Statistics: Number of readings, mean, standard deviation, coefficient of variation, highest and lowest reading can all be displayed or a selection from this list displayed as required.

Substrate: The base material onto which the coating is applied. In the case of the Elcometer 456 the substrate will always be a metal.

Top: One of the three feature versions of the gauge with capacity for storage of upto 40,000 readings in upto 999 batches.

USA Gauge Setting: Default settings for the gauge for the USA. Sets the units to imperial, the calendar to MM/DD/YY format and all other settings to default condition.

Zero Offset: Correction method for measurement of coatings applied to rough surfaces. A value is subtracted from each reading to compensate for the effects of the rough surface; the value depends on the actual profile. This method is also known as the ISO method, the Australian National Standard method and the SSPC method.