



## **International Standards and Calibration**

Calibration of Digital Dry Film Thickness Gauge  
On Profiled Surfaces



## International Standards

**The two most frequently asked questions we are asked about the Elcometer 456 are:**

Relevant standards for gauges

Standards bodies and training organisations

Standards

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## International Standards

### **The two most frequently asked questions we are asked about the Elcometer 456 are:**

- How do I calibrate the gauge on a profiled surface?

Relevant standards for gauges

Standards bodies and training organisations

Standards

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## International Standards

### **The two most frequently asked questions we are asked about the Elcometer 456 are:**

- How do I calibrate the gauge on a profiled surface?
- How often should I calibrate the gauge?

Relevant standards for gauges

Standards bodies and training organisations

Standards

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# International Standards

Relevant standards for gauges are on [elcometer.com](http://elcometer.com)

## STANDARDS:

AS 2331.1.4, AS 3894.3-B, AS/NZS 1580.108.1, ASTM B 499, ASTM D 1186-B, ASTM D 1400, ASTM D 7091, ASTM E 376, ASTM G 12, BS 3900-C5-6B, BS 3900-C5-6A, BS 5411-11, BS 5411-3, BS 5599, DIN 50981, DIN 50984, ECCA T1, EN 13523-1, IMO MSC.215(82), IMO MSC.244 (83), ISO 1461, ISO 19840, ISO 2063, ISO 2178, ISO 2360, ISO 2808-6A, ISO 2808-6B, ISO 2808-7C, ISO 2808-7D, ISO 2808-12, NF T30-124, SS 184159, SSPC PA 2, US Navy PPI 63101-000, US Navy NSI 009-32

Standards in grey have been superseded but are still recognised in some industries.

This list is for the Elcometer 456

The screenshot shows the Elcometer website interface for the Elcometer 456 Coating Thickness Gauge. The page includes a search bar, navigation menu, and a breadcrumb trail: Home > Inspection Equipment > Coating Inspection > Dry Film Thickness > Digital > Elcometer 456 Coating Thickness Gauge. The main content area is titled 'Elcometer 456 Coating Thickness Gauge' and features a 'Technical Specification' tab. Below this, there are sections for 'Integral Model Options' and 'Scale 1' and 'Scale 2'. Each section contains a table with columns for Model B, Model S, and Model T, and a 'C' column. The tables list various gauge models and their associated standards. For example, under Scale 1, Model B includes A456CFB11, Model S includes A456CFS11, and Model T includes A456CFT11. The 'C' column contains a red dot icon. Below the tables, there are sections for dimensions, gauge weight, operating temperature, and packing list. A 'STANDARDS:' section lists various international standards, with some in grey indicating they are superseded. A note at the bottom states: 'Standards in grey have been superseded but are still recognised in some industries.'

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Home Inspection Equipment Coating Inspection Dry Film Thickness Digital Elcometer 456 Coating Thickness Gauge

Product Description **Technical Specification** Accessories Instruction Manual Data Sheet Videos

### Elcometer 456 Coating Thickness Gauge

**Technical Specification**

**Integral Model Options**

**Scale 1** Range: 0-1500µm (0-60mils) Accuracy\*: ±1.3% or ±2.5µm (±0.1mil)  
Resolution: 0.1µm: 0-100µm; 1µm: 100-1500µm (0.01mil: 0-5mils; 0.1mil: 5-60mils)

	Model B	Model S	Model T	C
Elcometer 456 Ferrous Integral	A456CFB11	A456CFS11	A456CFT11	•
Elcometer 456 Non-Ferrous Integral	A456CNB11	See separate gauges with N2 PINIP <sup>®</sup> Probe	See separate gauges with N2 PINIP <sup>®</sup> Probe	•
Elcometer 456 Dual FNF Integral	A456CFNB11	A456CFNFS11	A456CFNFT11	•

**Scale 2** Range: 0-5mm (0-200mils) Accuracy\*: ±1.3% or ±20µm (±1.0mil)  
Resolution: 1µm: 0-1mm; 10µm: 1-5mm (0.1mil: 0-50mils; 1mil: 50-200mils)

For higher resolution & accuracy on thin coatings Scale 2 gauges can be switched to the Scale 1 mode measurement performance

	Model B	Model S	Model T	C
Elcometer 456 Ferrous Integral	A456CFB12	See separate gauges with F2 PINIP <sup>®</sup> Probe	See separate gauges with F2 PINIP <sup>®</sup> Probe	•

(h x w x d) 141 x 73 x 37mm (5.55 x 2.87 x 1.46")  
Gauge weight 161g (5.66oz) including supplied batteries  
Operating temperature -10 to 50°C (14 to 122°F)  
Packing List Elcometer 456 gauge, calibration foils (integrals only), wrist harness, transit case (T), protective case (B, S, T), 1 x screen protectors (S, T), 2 x AA batteries, operating instructions, USB cable (S, T), ElcoMaster<sup>®</sup> software (S, T)

\* Using default settings & lithium batteries, alkaline or rechargeable batteries may differ

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This list is for the Elcometer 456



Standards are current and in daily use

**elcometer** EN Search...

Home » Inspection Equipment » Coating Inspection » Dry Film Thickness » Digital » Elcometer 456 Coating Thickness Gauge

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### Elcometer 456 Coating Thickness Gauge

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→ Standards are current and in daily use



→ Standards are obsolete

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# International Standards



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# International Standards

→ Elcometer are involved with:

- Standards Bodies
- Training Organisations



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# International Standards

## → Elcometer are involved with:

- Standards Bodies
- Training Organisations



→ Gauges comply to the needs of the standards and test methods

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# International Standards

Many Standards and Test Methods  
reference each other

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# International Standards

Many Standards and Test Methods  
reference each other

## **We will reference**

- SSPC PA2
- ASTM D 7091
- ISO 8503

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## **International Standards and Calibration**

Calibration of Digital Dry Film Thickness Gauge  
On Profiled Surfaces



# Calibration

Rough  
Coated  
Substrates

Calibrating  
the Gauge

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# Calibration

## Blasted Rough surface



- Rough / 2 Point Cal
- Zero Offset Cal

Rough  
Coated  
Substrates

Calibrating  
the Gauge

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# Calibration

## Blasted Rough surface



- Rough / 2 Point Cal
- Zero Offset Cal

## Non Blasted Smooth Surface



- Smooth Cal

Rough  
Coated  
Substrates

Calibrating  
the Gauge

elcometer®

# Calibration

## Blasted Rough surface



- Rough / 2 Point Cal
- Zero Offset Cal

## Non Blasted Smooth Surface



- Smooth Cal

### Calibration Methods

Calibration Methods are selected in the Cal Menu



Rough Coated Substrates

Calibrating the Gauge

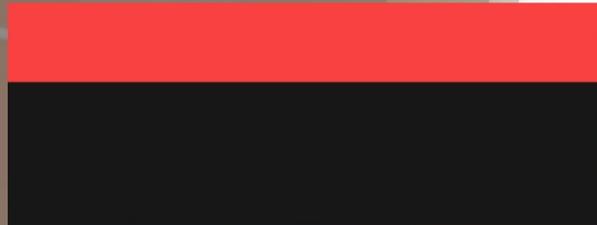
## Coated Blasted Surface

- Uneven Surface
- Variation in individual readings

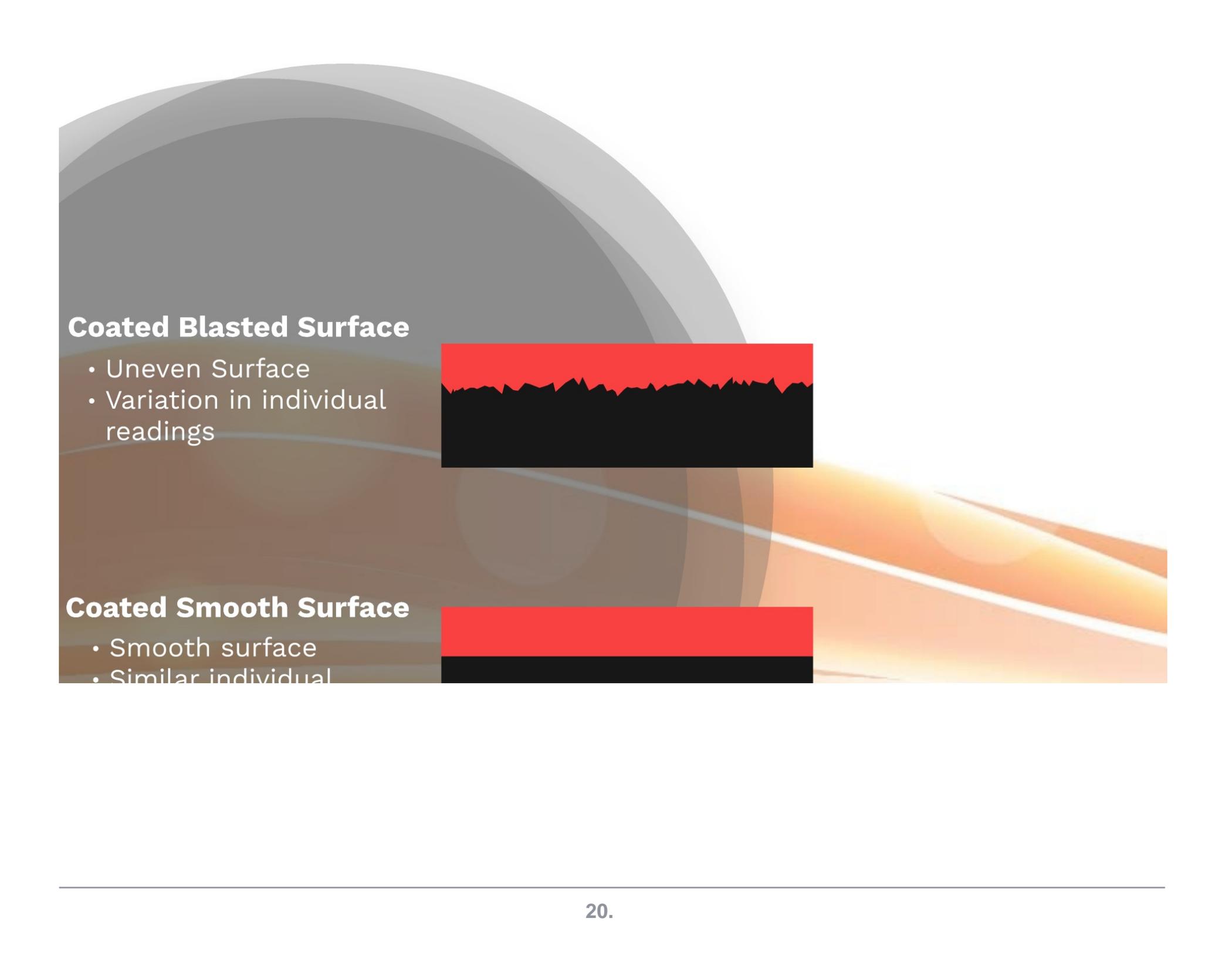


## Coated Smooth Surface

- Smooth surface
- Similar individual readings



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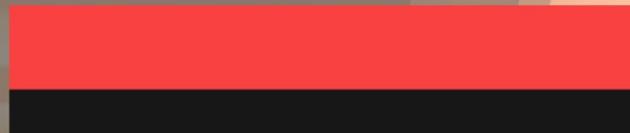
## Coated Blasted Surface

- Uneven Surface
- Variation in individual readings



## Coated Smooth Surface

- Smooth surface
- Similar individual



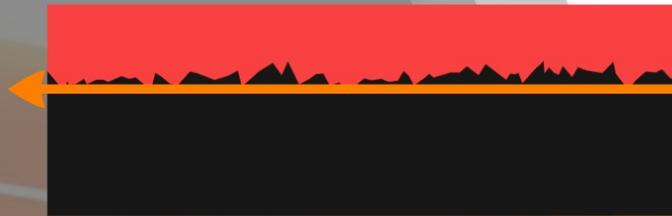
## Coated Blasted Surface

- Uneven Surface
- Variation in individual readings



## Coated Blasted Surface

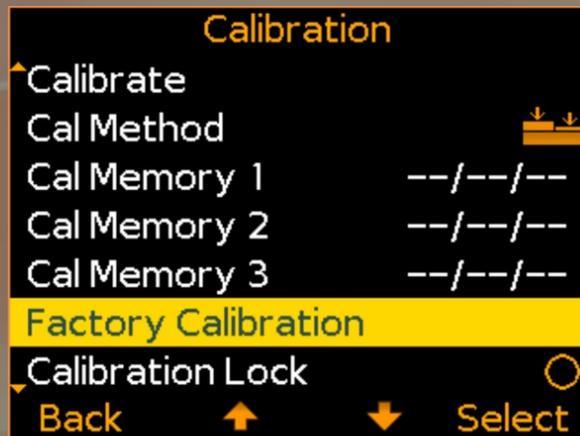
- Uneven Surface
- Variation in individual readings



**Rough Calibration methods** average out variation caused by profile

## Calibration

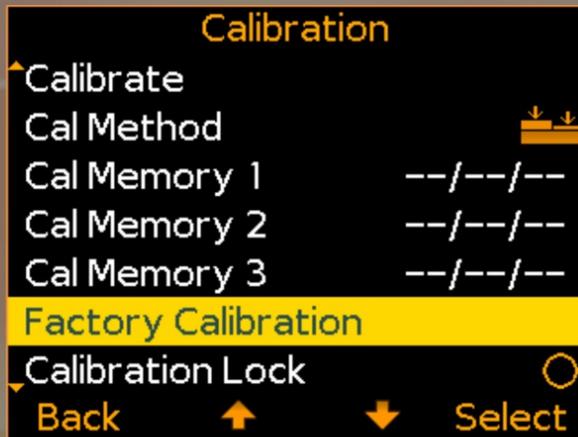
- Elcometer calibrate the gauge
- Stored as Factory Calibration
- Out of box -  $\pm 3\%$  accuracy
- Gauge calibration adjusts Factory Calibration



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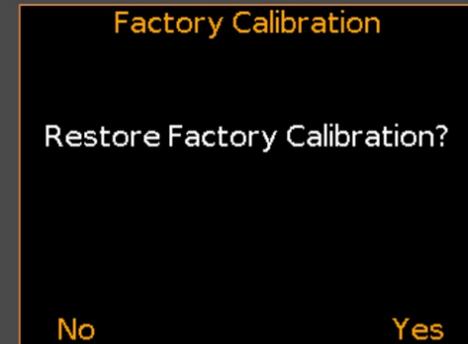
## Calibration

- Elcometer calibrate the gauge
- Stored as Factory Calibration
- Out of box -  $\pm 3\%$  accuracy
- Gauge calibration adjusts Factory Calibration



### “What happens if I make a mistake?”

- Restore Factory Calibration
- Continue with gauge calibration
- Once calibrated accuracy  $\pm 1\%$



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## International Standards and Calibration

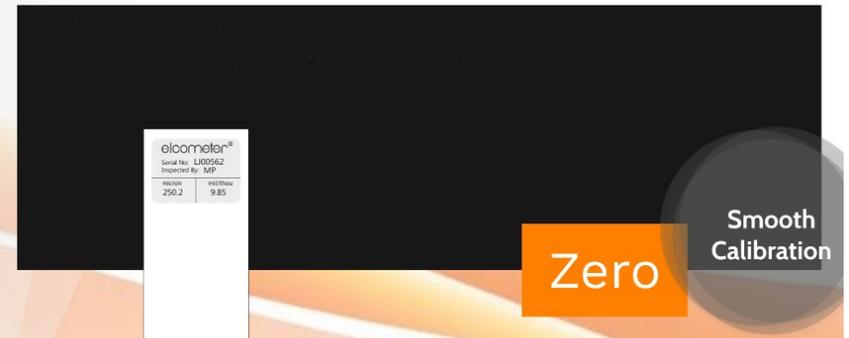
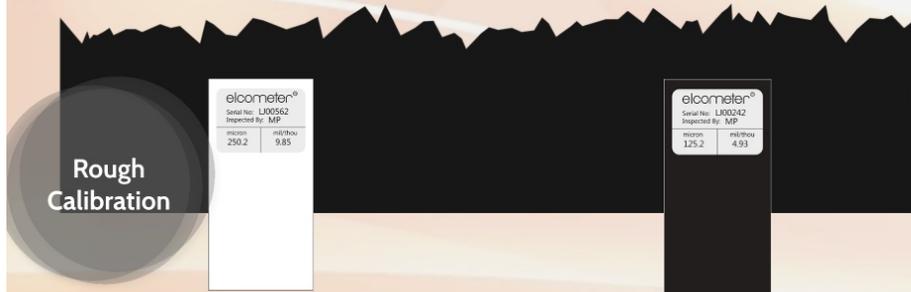
Calibration of Digital Dry Film Thickness Gauge  
On Profiled Surfaces



# All calibration methods require us to enter two absolute/known values into the gauge

## Rough Calibration

## Smooth Calibration



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# Rough Calibration

Rough  
Calibration

elcometer®	
Serial No: LJ00562	
Inspected By: MP	
micron	mil/thou
250.2	9.85

elcometer®	
Serial No: LJ00242	
Inspected By: MP	
micron	mil/thou
125.2	4.93

# Rough Calibration

Rough  
Calibration

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micron	mil/thou
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elcometer®	
Serial No: LJ00242	
Inspected By: MP	
micron	mil/thou
125.2	4.93

- Rough: 2 absolute values
- Target Value = NDFT
- High Foil Value > NDFT
- Low Foil Value < NDFT

# Smooth Calibration

elcometer®	
Serial No: U00562	
Inspected By: MP	
micron	mil/thou
250.2	9.85

Zero

Smooth  
Calibration

# Smooth Calibration

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Inspected By: MP	
micron	mil/thou
250.2	9.85

Zero

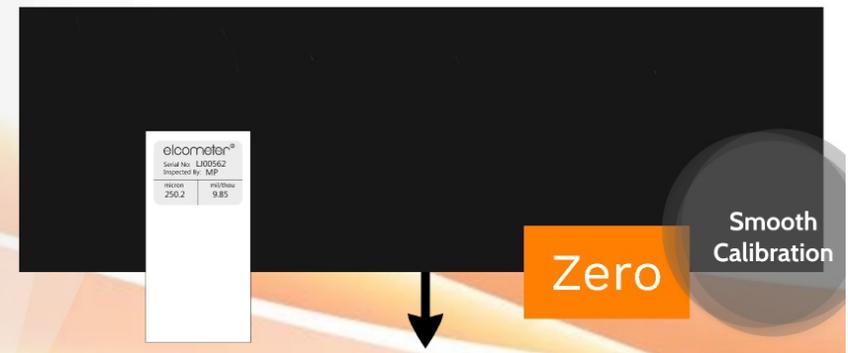
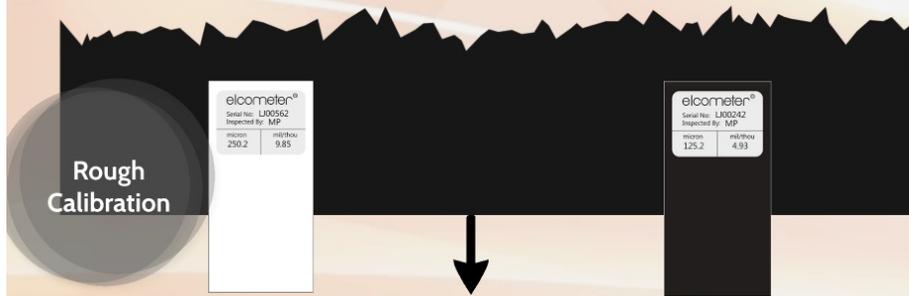
Smooth  
Calibration

- Smooth : 2 absolute values
- High Foil Value > NDFT
- Zero / Substrate

# All calibration methods require us to enter two absolute/known values into the gauge

## Rough Calibration

## Smooth Calibration



- Rough: 2 absolute values
- Target Value = NDFT
- High Foil Value > NDFT
- Low Foil Value < NDFT

- Smooth : 2 absolute values
- High Foil Value > NDFT
- Zero / Substrate

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## Rough Calibration/ Blasted Surface

- No absolute zero reference
- Use two foils of known value



2 Point  
Calibration

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## Rough Calibration/ Blasted Surface

- No absolute zero reference
- Use two foils of known value

### For this demonstration

NDFT = 180  $\mu\text{m}$   
High Foil = 250  $\mu\text{m}$   
Low Foil = 125  $\mu\text{m}$



2 Point  
Calibration

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## Rough Calibration/ Blasted Surface

- No absolute zero reference
- Use two foils of known value

### For this demonstration

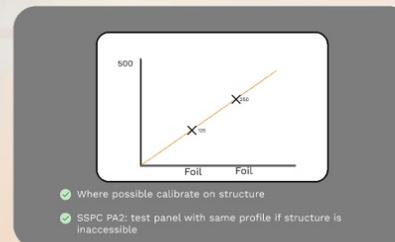
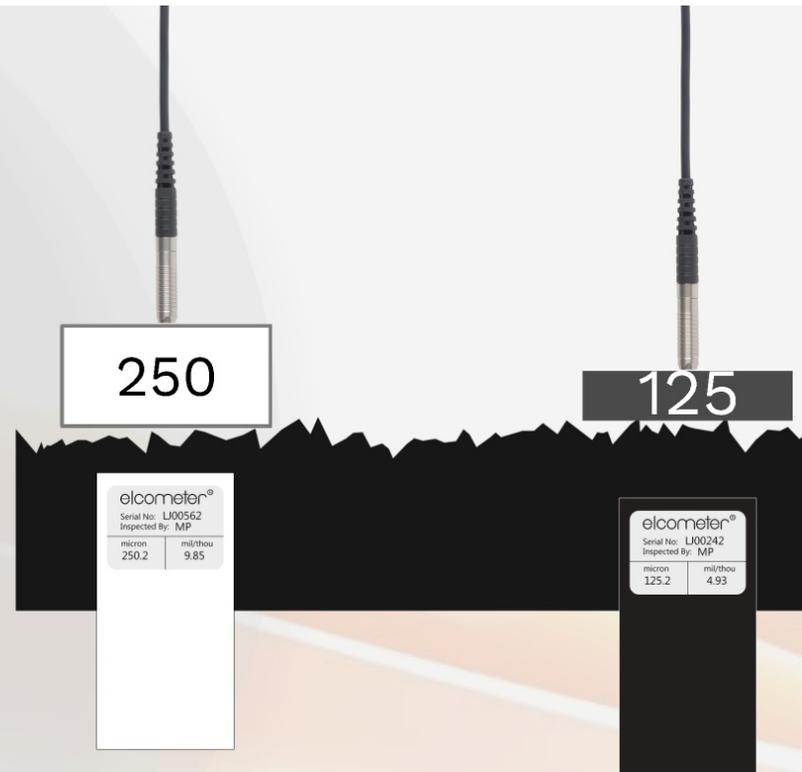
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2 Point  
Calibration

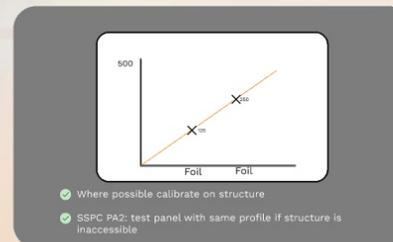
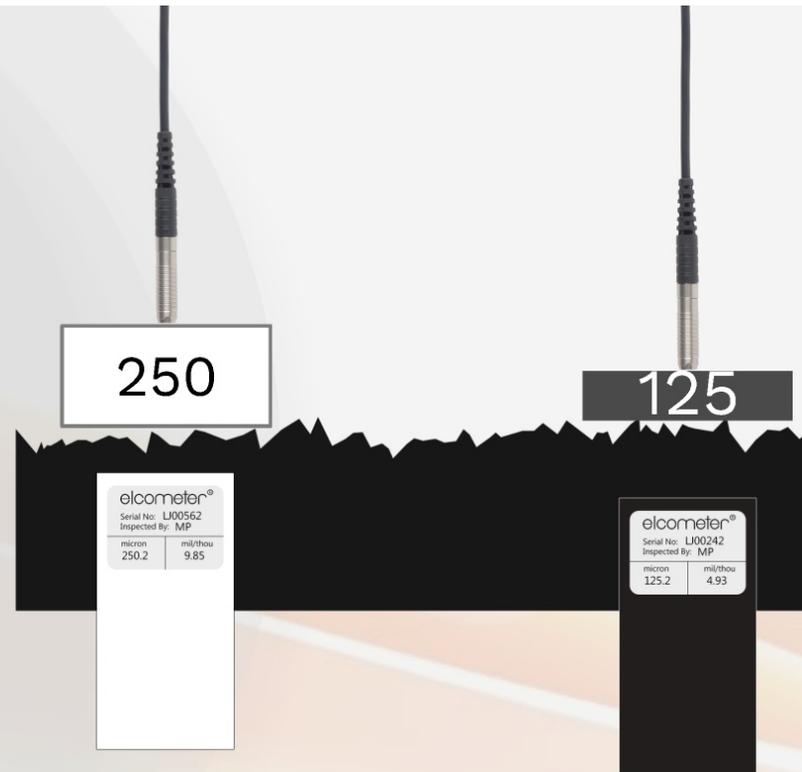
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# 2 Point Calibration



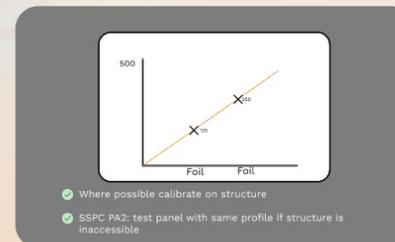
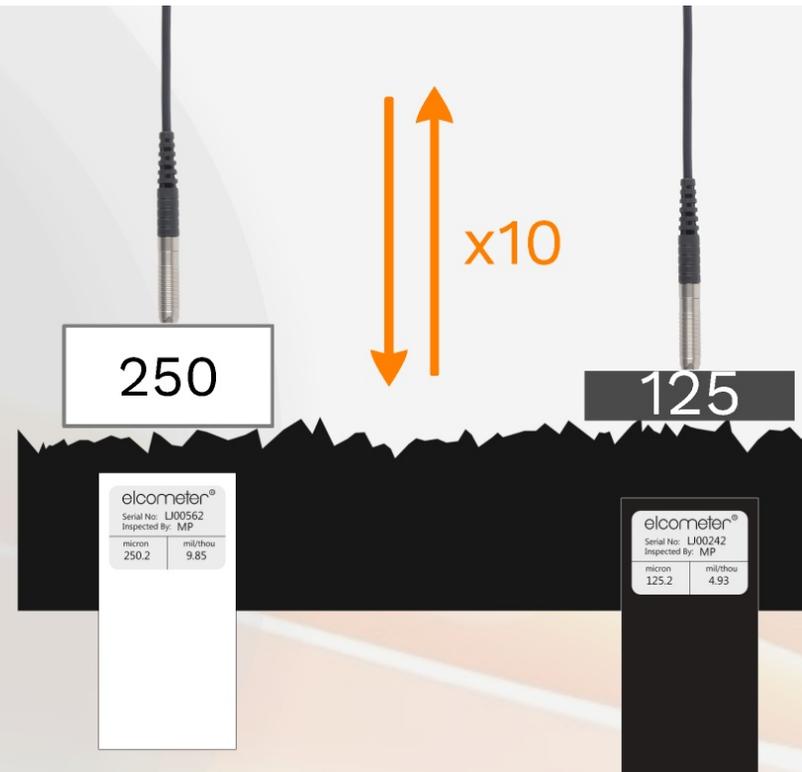
## 2 Point Calibration

- SSPC PA2 – minimum 10 readings to average
- Elcometer minimum 5
- Not possible to take too many
- Only possible to take too few



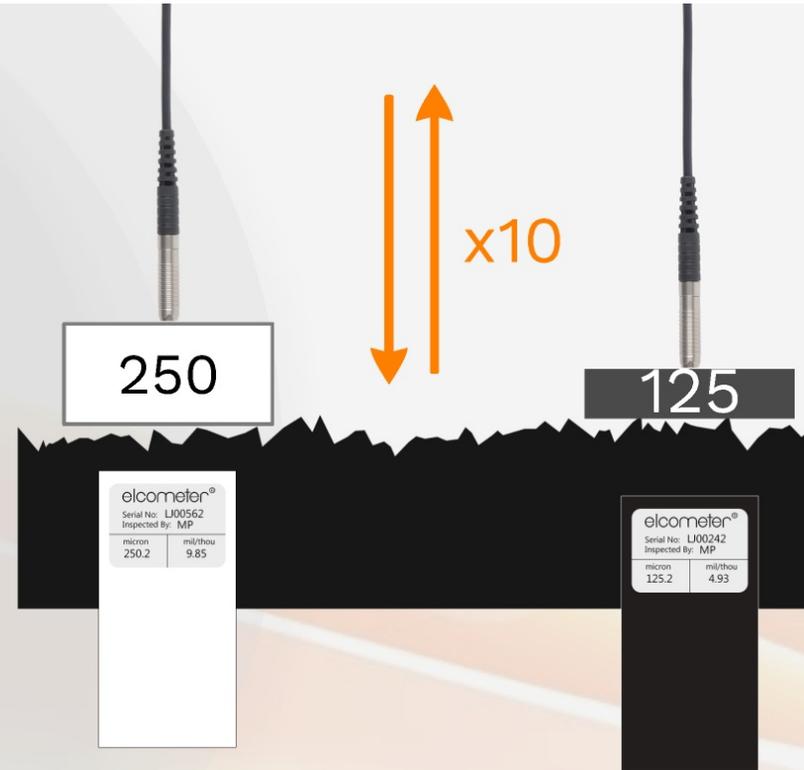
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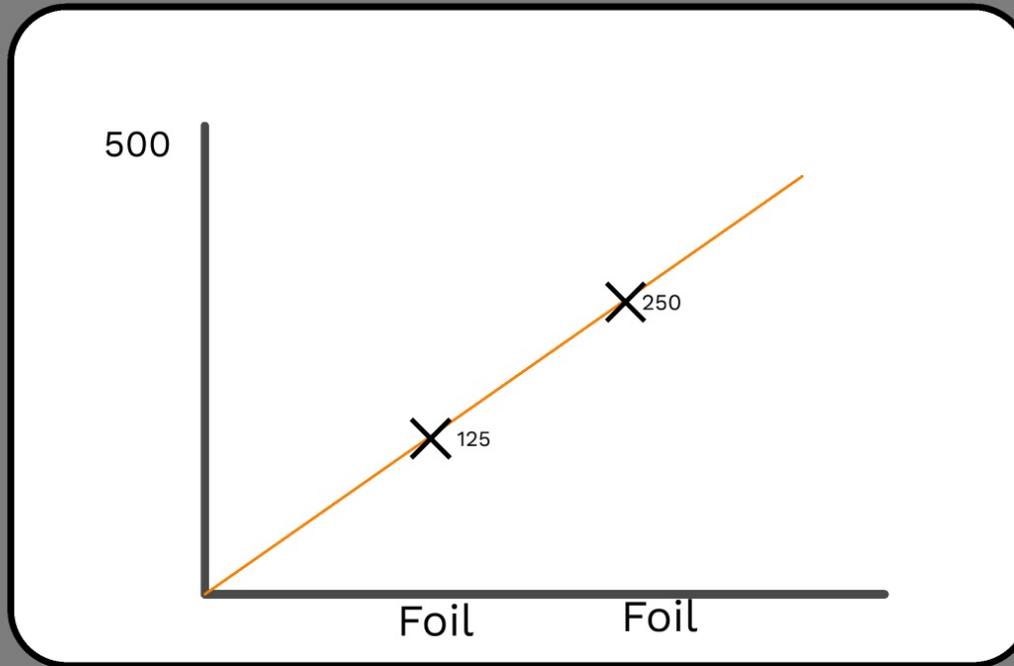


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- SSPC PA2 – minimum 10 readings to average
- Elcometer minimum 5
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- Only possible to take too few



Adjust measured values on gauge to value of foils  
This allows the gauge to 'plot' a graph relevant to the substrate



- ✓ Where possible calibrate on structure
- ✓ SSPC PA2: test panel with same profile if structure is inaccessible

# Smooth Calibration

250

elcometer®	
Serial No: LJ00562	
Inspected By: MP	
micron	mil/thou
250.2	9.85

zero

elcometer®

## Smooth Calibration

- Adjust the measured value on the gauge to the value of the foil
- Adjust the zero value of the gauge after measuring surface
- This allows the gauge to 'plot' a graph relevant to the substrate



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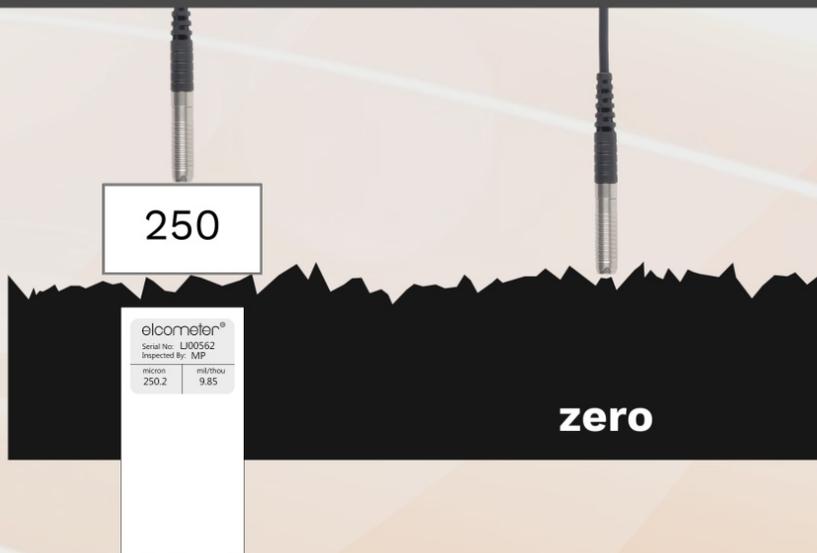


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# Common Mistake #1

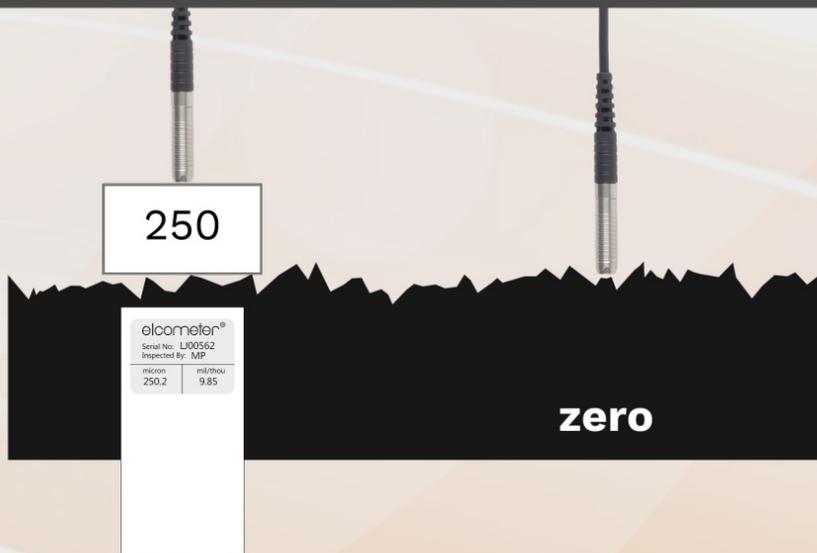
- High value foil only
- Attempt to 'zero' on an uneven surface



Common  
Mistake #2

# Common Mistake #1

- High value foil only
- Attempt to 'zero' on an uneven surface

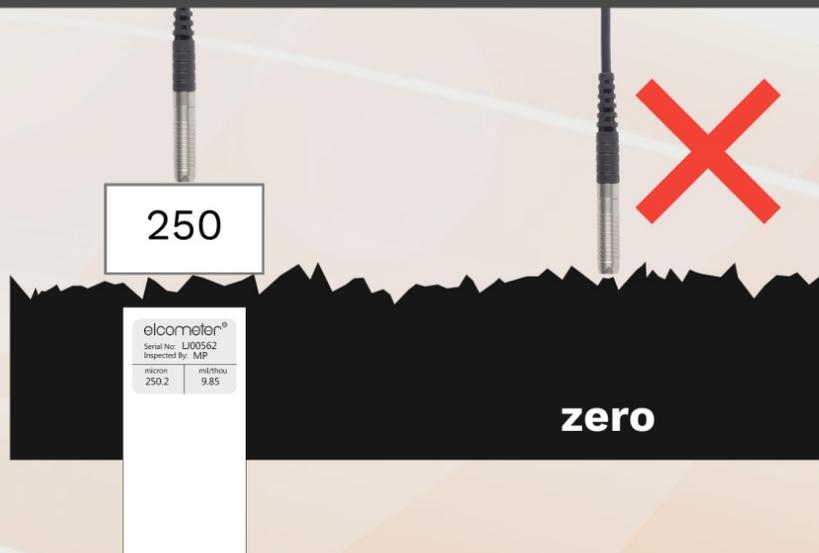


**This does not work**

**Common  
Mistake #2**

# Common Mistake #1

- High value foil only
- Attempt to 'zero' on an uneven surface

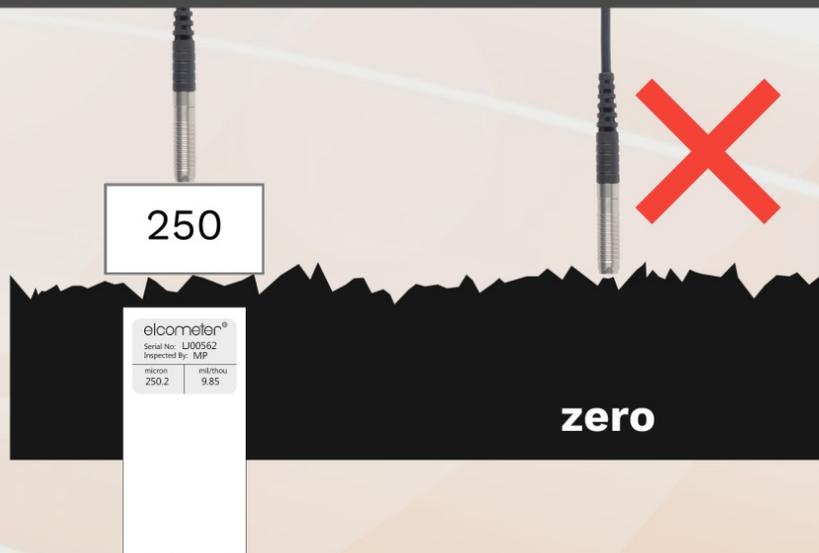


**This does not work**

**Common  
Mistake #2**

# Common Mistake #1

- High value foil only
- Attempt to 'zero' on an uneven surface



**This does not work**

**Common  
Mistake #2**

## Common Mistake #2

- Smooth calibration - measure profiled surface
- This will OVERSTATE thickness of coating
- Error increases with deeper profiles

250

elcometer®  
Serial No: LI00562  
Inspected By: MP

micron	mil/thou
250.2	9.85

Zero



## Common Mistake #2

- Smooth calibration - measure profiled surface
- This will OVERSTATE thickness of coating
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250

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Zero





## **International Standards and Calibration**

Calibration of Digital Dry Film Thickness Gauge  
On Profiled Surfaces



# Zero Offset Calibration

SSPC PA2

Method

elcometer®

# Zero Offset Calibration

Used when no access to profiled surface

Use zero plate

SSPC PA2

Method

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# Zero Offset Calibration

**Used when no access to profiled surface**

Use zero plate

**Similar to Smooth Calibration**

An additional step in the method

SSPC PA2

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# Zero Offset Calibration

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SSPC PA2

Method

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# Zero Offset Calibration

Used when no access to profiled surface

Use zero plate

Similar to Smooth Calibration

An additional step in the method

- **Difference to Smooth Cal is the addition of an offset value**
- **Select Zero Offset**  
Enter an offset value
- **The offset value is subtracted from all readings**  
This value prevents the reading being overstated



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## SSPC PA2

**SSPC PA2 refers to 'correction values'**

Offset Value = Correction Value  
Values vary according to the depth of  
the profile

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**SSPC PA2 refers to 'correction values'**

Offset Value = Correction Value  
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**SSPC PA2 refers to ISO 8503**

**ISO 8503 correction values**

- Fine –
- Medium –
- Coarse –

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**ISO 8503 correction values**

- Fine – correction value 10  $\mu\text{m}$
- Medium –
- Coarse –

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**SSPC PA2 refers to 'correction values'**

Offset Value = Correction Value  
Values vary according to the depth of the profile

**SSPC PA2 refers to ISO 8503**

**ISO 8503 correction values**

- Fine – correction value 10  $\mu\text{m}$
- Medium - correction value 25  $\mu\text{m}$
- Coarse –

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# SSPC PA2

**SSPC PA2 refers to 'correction values'**

Offset Value = Correction Value  
Values vary according to the depth of the profile

**SSPC PA2 refers to ISO 8503**

**ISO 8503 correction values**

- Fine – correction value 10  $\mu\text{m}$
- Medium - correction value 25  $\mu\text{m}$
- Coarse – correction value 40  $\mu\text{m}$

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# SSPC PA2

## SSPC PA2 refers to 'correction values'

Offset Value = Correction Value  
Values vary according to the depth of the profile

### SSPC PA2 refers to ISO 8503

#### ISO 8503 correction values

- Fine – correction value 10  $\mu\text{m}$
- Medium - correction value 25  $\mu\text{m}$
- Coarse – correction value 40  $\mu\text{m}$

SSPC PA2 recommends that for most applications 25  $\mu\text{m}$  is recommended

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# SSPC PA2

## SSPC PA2 refers to 'correction values'

Offset Value = Correction Value  
Values vary according to the depth of the profile

### SSPC PA2 refers to ISO 8503

#### ISO 8503 correction values

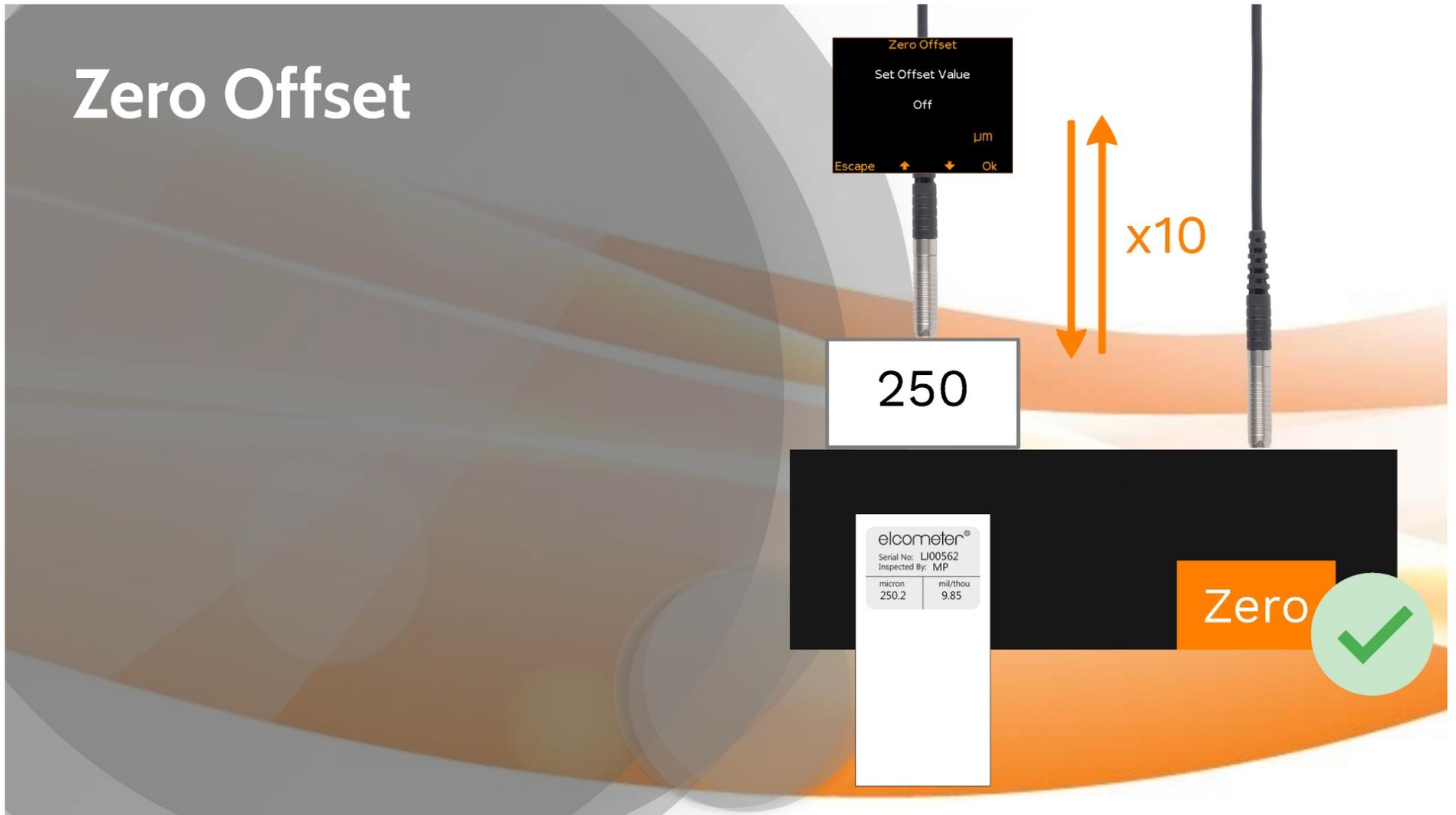
- Fine – correction value 10  $\mu\text{m}$
- Medium - correction value 25  $\mu\text{m}$
- Coarse – correction value 40  $\mu\text{m}$

SSPC PA2 recommends that for most applications 25  $\mu\text{m}$  is recommended

- Other test methods recommend using 1/3rd of the profile depth as the offset or correction value
- 75  $\mu\text{m}$  is a commonly specified profile depth
- 1/3rd of 75  $\mu\text{m}$  and SSPC PA2 recommendation of 25  $\mu\text{m}$  agree

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# Zero Offset



# Zero Offset

- Enter the offset value as determined by profile depth
- Complete the calibration routine = Smooth
- Test calibration successful and end

Zero Offset  
Set Offset Value  
Off  
µm  
Escape ↑ ↓ Ok

250

x10

elcometer®  
Serial No: LJ00562  
Inspected By: MP

micron	mil/thou
250.2	9.85

Zero



# Zero Offset

- Enter the offset value as determined by profile depth
- Complete the calibration routine = Smooth
- Test calibration successful and end

Enter 25µm  
Offset Value

Zero Offset  
Set Offset Value  
Off  
µm  
Escape ↑ ↓ Ok

250

x10

elcometer®	
Serial No: LJ00562	
Inspected By: MP	
micron	mil/thou
250.2	9.85

Zero



# Zero Offset

- Enter the offset value as determined by profile depth
- Complete the calibration routine = Smooth
- Test calibration successful and end
- **Offset values correct readings when measuring profiled surfaces**

Enter 25µm  
Offset Value

Zero Offset  
Set Offset Value  
Off  
µm  
Escape ↑ ↓ Ok

250

x10

elcometer®  
Serial No: LJ00562  
Inspected By: MP  
micron 250.2    mil/thou 9.85

Zero





250

elcometer®  
Serial No: LJ00562  
Inspected By: MP

micron	mil/thou
250.2	9.85

- Re-measure the 250  $\mu\text{m}$  foil

250

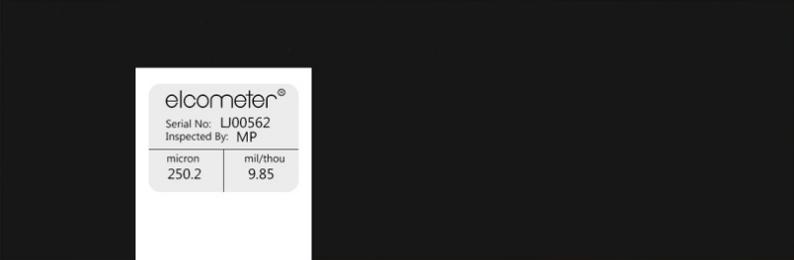
elcometer®  
Serial No: LJ00562  
Inspected By: MP

micron	mil/thou
250.2	9.85



- Re-measure the 250  $\mu\text{m}$  foil
- Reading on screen = 225  $\mu\text{m}$

250





- Re-measure the 250  $\mu\text{m}$  foil
- Reading on screen = 225  $\mu\text{m}$
- 250  $\mu\text{m}$  – 25  $\mu\text{m}$  = 225  $\mu\text{m}$

250

elcometer®  
Serial No: LJ00562  
Inspected By: MP

micron	mil/thou
250.2	9.85



- Re-measure the 250 µm foil
- Reading on screen = 225 µm
- $250 \mu\text{m} - 25 \mu\text{m} = 225 \mu\text{m}$
- Replicates Rough / 2 Point Cal

250

elcometer®	
Serial No: LJ00562	
Inspected By: MP	
micron	mil/thou
250.2	9.85



=

250

elcometer®	
Serial No: LJ00562	
Inspected By: MP	
micron	mil/thou
250.2	9.85

125

elcometer®	
Serial No: LJ00242	
Inspected By: MP	
micron	mil/thou
125.2	4.93



## **International Standards and Calibration**

Calibration of Digital Dry Film Thickness Gauge  
On Profiled Surfaces



# Calibration Data

Questions

Test  
Calibration

ElcoMaster®

# Calibration Data

- All calibration data is stored in gauge
- Every batch will use the stored calibration



Batch Information	
Batch 5	
Created	15:08 08/04/2020
Type	Normal 
Cal Method	Rough / 2 Point 
High Limit Value	--
Low Limit Value	--
Probe	F2 KJ03022
<a href="#">Back</a>	

Questions

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Back	

Questions

Test  
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Batch Information	
Batch 5	
Created	15:08 08/04/2020
Type	Normal #
Cal Method	Rough / 2 Point ⬇️⬆️
High Limit Value	--
Low Limit Value	--
Probe	F2 KJ03022
<a href="#">Back</a>	

Full calibration details are recorded

Calibration Information	
Batch 5	
Substrate	Ferrous 1
Calibrated	15:01 08/04/20
Probe	F2 : KJ03022
Cal Method	Rough / 2 Point ⬇️⬆️
Thick Foil	250 µm
Thin Foil / Base	125 µm
<a href="#">Back</a>	<a href="#">Next</a>

Questions

Test  
Calibration

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# Calibration Data

- All calibration data is stored in gauge
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Batch Information	
Batch 5	
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Type	Normal #
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High Limit Value	--
Low Limit Value	--
Probe	F2 KJ03022
Back	

Full calibration details are recorded

Calibration Information	
Batch 5	
Substrate	Ferrous 1
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Probe	F2 : KJ03022
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Back	Next

Questions

Test  
Calibration

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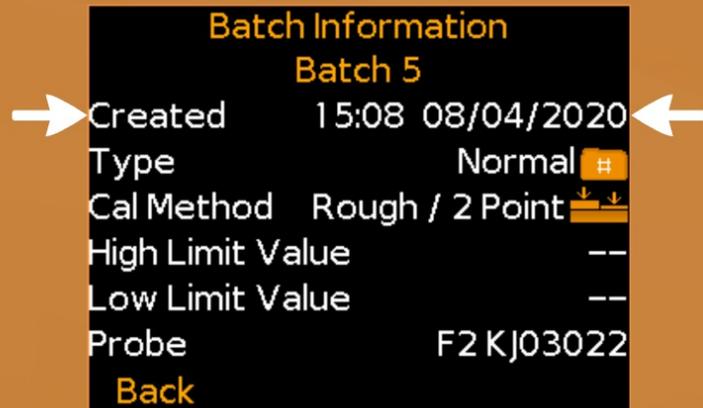
**“How often should we calibrate?”**

**“Why calibrate?”**

## “How often should we calibrate?”

SSPC PA2 says a minimum of at start and at end of shift

Elcometer recommend before each use



## “Why calibrate?”

## “How often should we calibrate?”

SSPC PA2 says a minimum of at start and at end of shift

Elcometer recommend before each use

Batch Information	
Batch 5	
Created	15:08 08/04/2020
Type	Normal #
Cal Method	Rough / 2 Point
High Limit Value	--
Low Limit Value	--
Probe	F2 KJ03022
Back	

## “Why calibrate?”

Batch Date & Cal Date are current

Confirm gauge

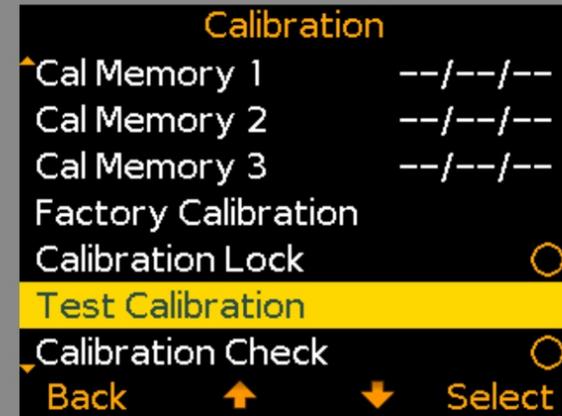
- Accurate
- Working

Calibration Information	
Batch 5	
Substrate	Ferrous 1
Calibrated	15:01 08/04/20
Probe	F2 : KJ03022
Cal Method	Rough / 2 Point
Thick Foil	250 µm
Thin Foil / Base	125 µm
Back	Next

## Test Calibration

- Quick Calibration

Use a foil with a thickness representative of calibration range



### Test Calibration

- Quick Calibration

Use a foil with a thickness representative of calibration range

### Readings and foil value are accurate

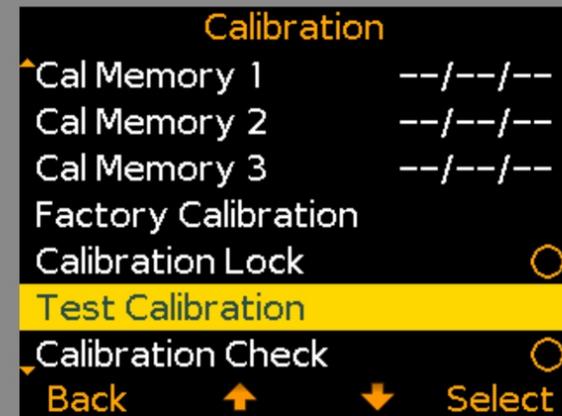
- Validate

Validate will update the Time & Date of the cal

### Readings and foil value are not accurate

- Cal

Cal will start the full calibration routine



### Test Calibration

- Quick Calibration

Use a foil with a thickness representative of calibration range

### Readings and foil value are accurate

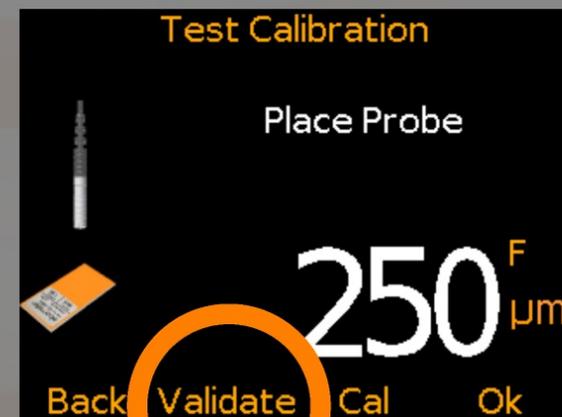
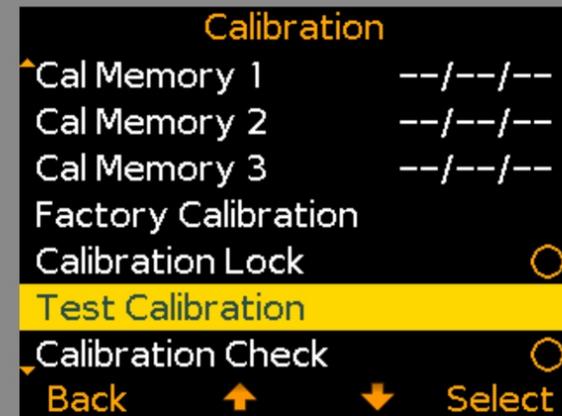
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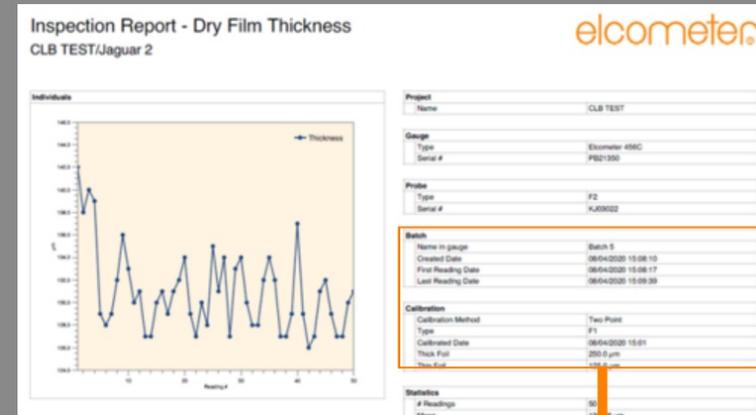
- Cal

Cal will start the full calibration routine



# ElcoMaster®

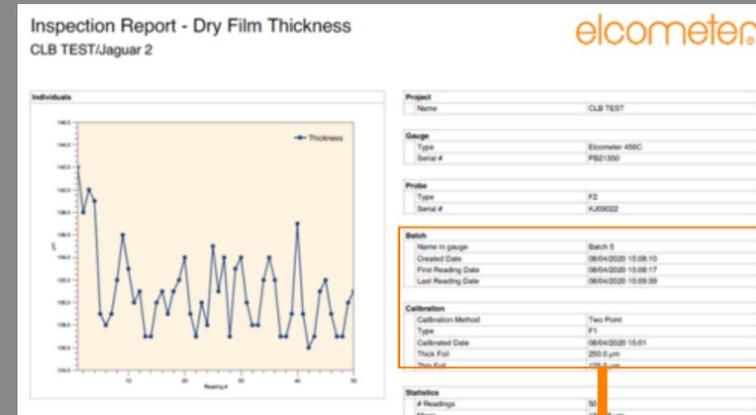
- Download batch data to ElcoMaster® Data Management Software
- All calibration data is automatically reported
- Professional reporting
- Full traceability



Batch	
Name in gauge	Batch 5
Created Date	08/04/2020 15:08:10
First Reading Date	08/04/2020 15:08:17
Last Reading Date	08/04/2020 15:09:39
Calibration	
Calibration Method	Two Point
Type	F1
Calibrated Date	08/04/2020 15:01
Thick Foil	250.0 $\mu\text{m}$
Thin Foil	125.0 $\mu\text{m}$

# ElcoMaster®

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Batch	
Name in gauge	Batch 5
Created Date	08/04/2020 15:08:10
First Reading Date	08/04/2020 15:08:17
Last Reading Date	08/04/2020 15:09:39
Calibration	
Calibration Method	Two Point
Type	F1
Calibrated Date	08/04/2020 15:01
Thick Foil	250.0 $\mu\text{m}$
Thin Foil	125.0 $\mu\text{m}$

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**Thank you for watching this webinar!**

To find out more on calibration, please visit:  
The Elcometer Inspection Equipment YouTube Channel.



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-  **Using the Zero Calibration feature of the Elcometer 456 Coating Thickness Gauge**  
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-  **Using the Elcometer 456 Zero Offset Calibration in accordance with ISO 19840 on Ferrous Substrates**  
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-  **Using the Auto Calibration feature of the Elcometer 456 Coating Thickness Gauge**  
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## Thank you for watching this webinar!

To find out more on calibration, please visit:  
The Elcometer Inspection Equipment YouTube Channel.



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or contact us at [techsales@elcometer.com](mailto:techsales@elcometer.com)



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