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PROTECTIVE COATINGS

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Material Thickness

Surface Profile

Surface Cleanliness

Climatic Testing

Wet Film Thickness

Dry Film Thickness

Adhesion

Pinhole & Porosity

Inspection Kits

60 years of excellence
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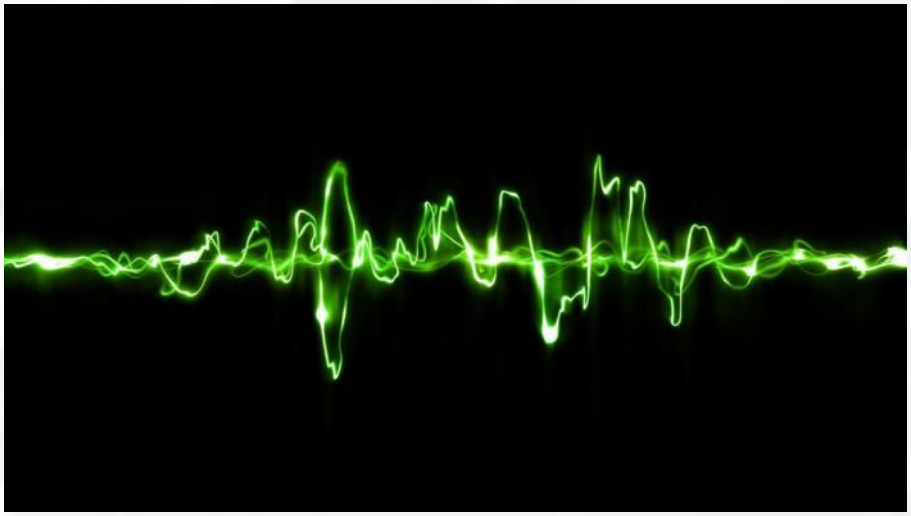
Ultrasonic Thickness Measurement

What are we going to learn



- What ultrasound is
- Why it is used
- Where it is used
- What the benefit is
- What instruments and probes are available
- Which instrument and probe to choose

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What is Ultrasound?

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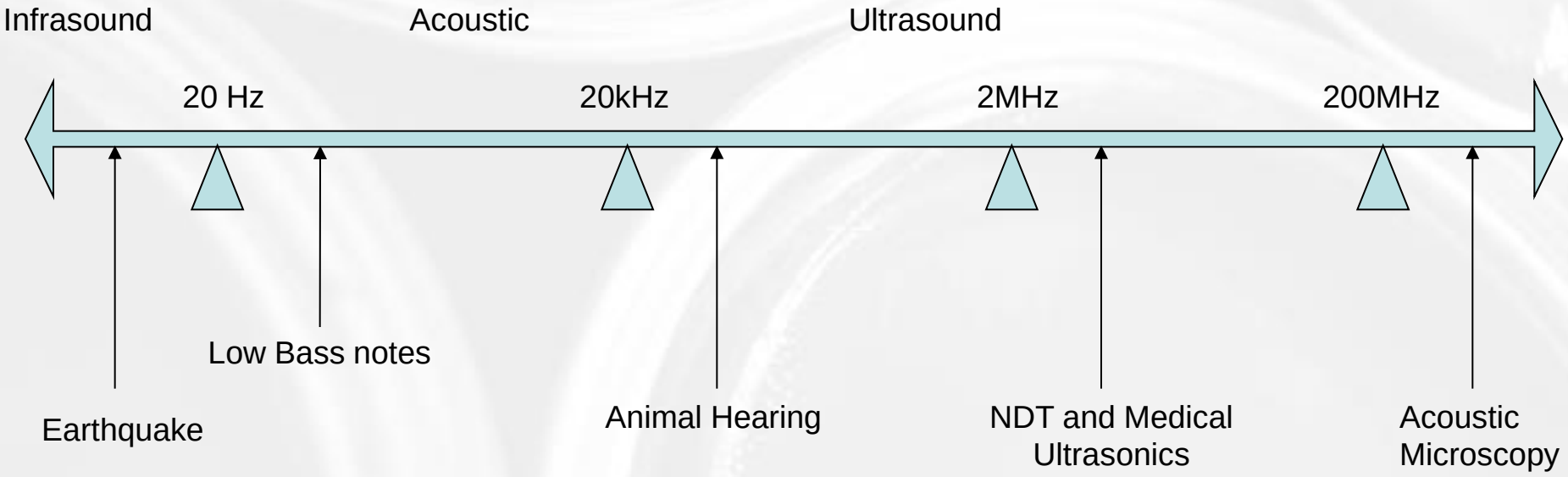
Ultrasound is sound with a frequency to high for humans to hear.


Infrasound
Acoustic
Ultrasound
20 Hz
20kHz
2MHz
200MHz
Earthquake
Low Bass notes
Animal Hearing
NDT and Medical Ultrasonics
Acoustic Microscopy

- UTGs generate a sound pulse in a probe called a transducer
- The transducer transmits the sound pulse into the material, through a layer of couplant

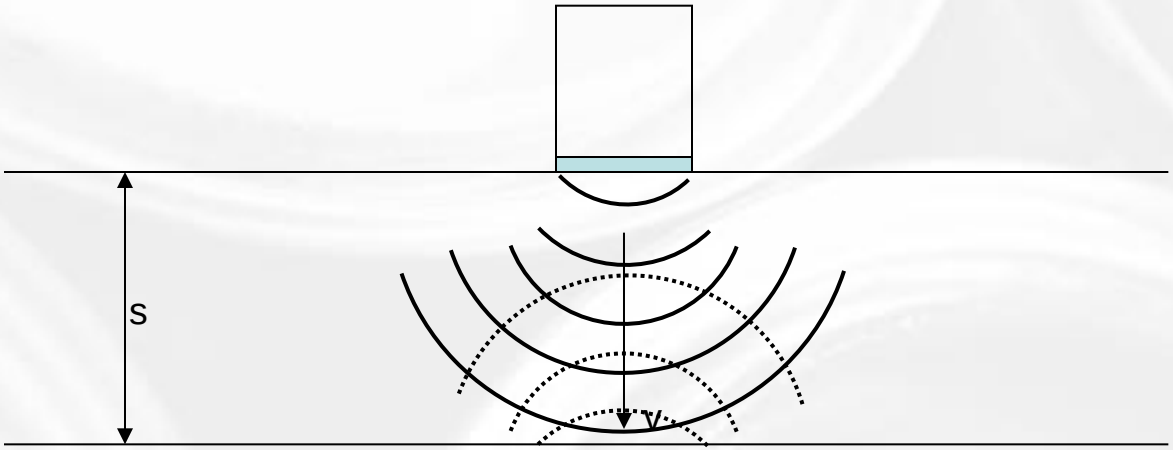
.

- Sound waves are reflected from the boundaries between dissimilar materials
- Metals and air
- Metals and liquids

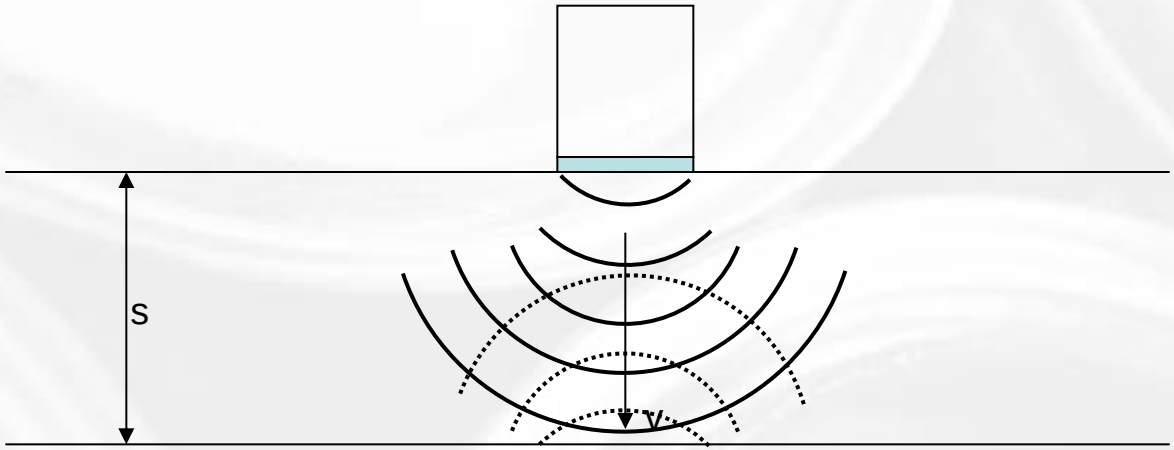
- The transducer listens for the echo coming back

- An accurate electronic timer is used to determine the interval between pulse and echo

The pulse is the burst of sound energy, like the bang of a drum. The echo is the same sound reflected back.



Time interval is usually measured in nanoseconds. The gauge is programmed with the speed of sound in the test material, from which it can then calculate thickness.



$$S = v \times \frac{t}{2}$$

Where s = substrate thickness
v = the velocity of sound in the substrate material
t = the measured round trip time (pulse to echo)

- v is an essential part of this calculation

- Different materials transmit sound at different velocities

Material	Speed of Sound
Rubber	60 m/s
Air at 40°C	355 m/s
Air at 20°C	343 m/s
Lead	1210 m/s
Gold	3240 m/s
Glass	4540 m/s
Copper	4600 m/s
Aluminum	6320 m/s

- Calibration of gauges sets the speed of sound
- Accuracy of instruments dependant on calibration
- Speed of sound can vary with different grades of a material
- Better to calibrate with a sample of known thickness than put in a speed of sound

Why use an Ultrasonic Thickness gauge?

- Access to only one side of a component
- Pipes
- Tubes
- Sealed vessels
- Where mechanical measurement is impossible due to limited access.

- Pits and flaws are also detectable from one side

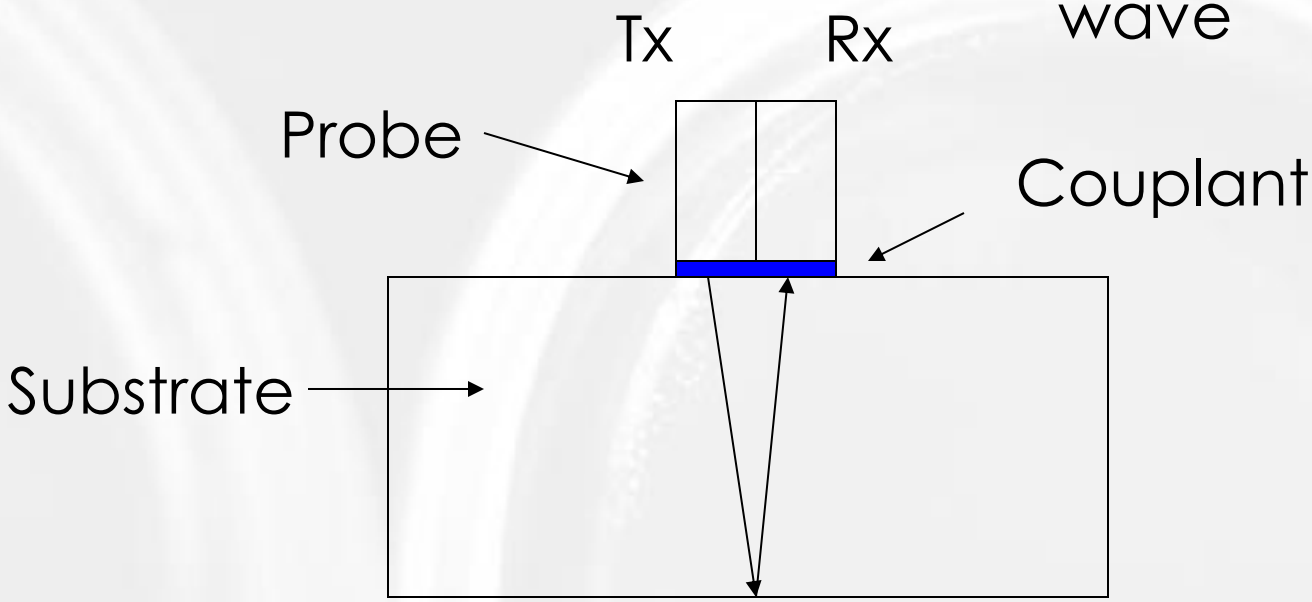
- No need to destroy the component to get access, hence NDT (Non-destructive testing)

Theory

- Measurement from one side
- Time of Flight Measurement
- Transmit/Receive Probes
- Velocity of Sound in Materials
- Couplant – ensures good acoustic contact

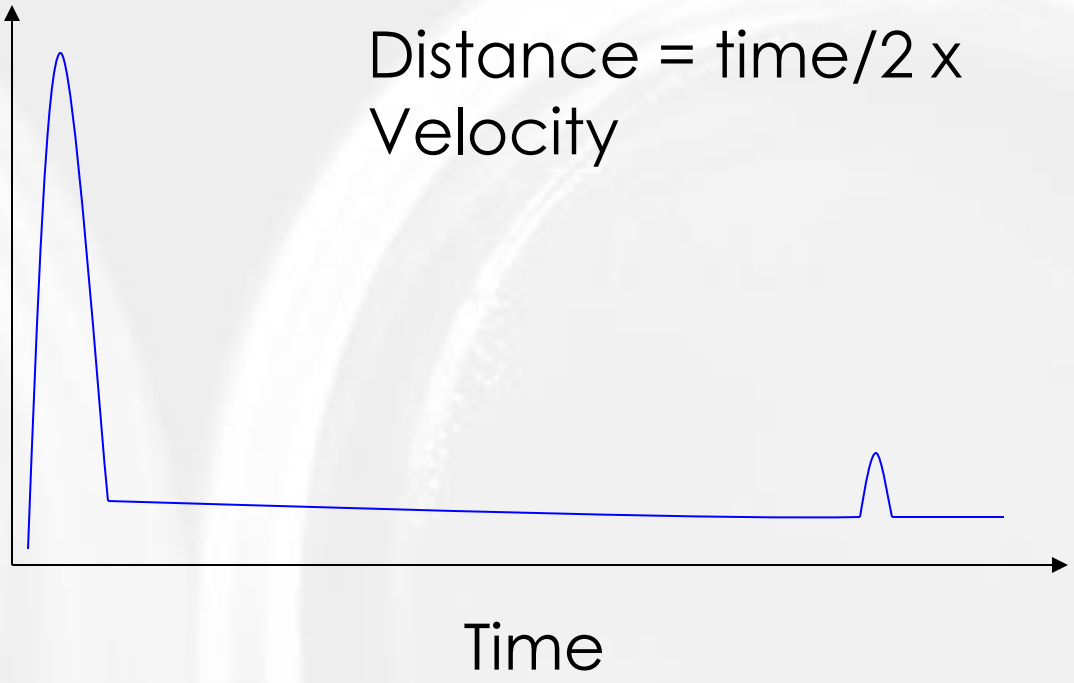
Theory

Pulse of electricity initiates sound wave



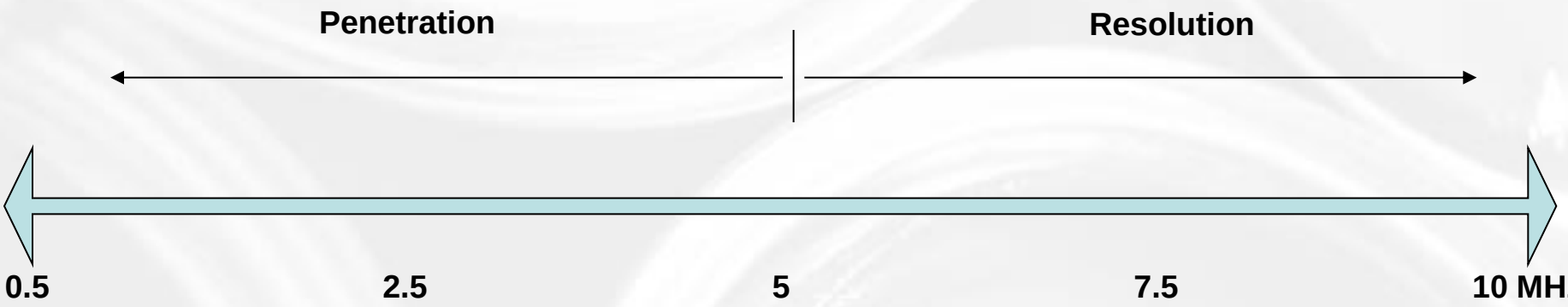
Theory

Probe Signal (v)



Distance = time/2 x Velocity

Time



Woofer

Cars at traffic lights

High Bass

Shouting in forest

Greater scatter

Tweeter

Treble

Clears the ringing

Increased “directivity”

Elcometer 204

- Precalibrated for steel
- Supplied with 5Mhz transducer

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Elcometer 304

- 2-Point, 1-Point, Material, Velocity, Thickness Set and Factory calibrations
- Measurement rate control (4, 8 and 16Hz)
- PE and EE modes
- Gauge memory up to 100,000 readings / 1000 batches

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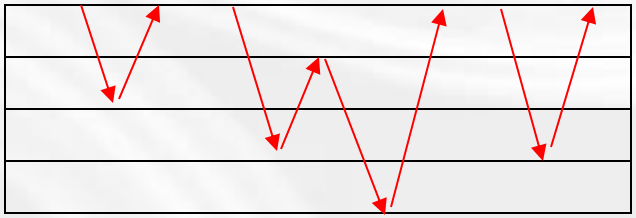
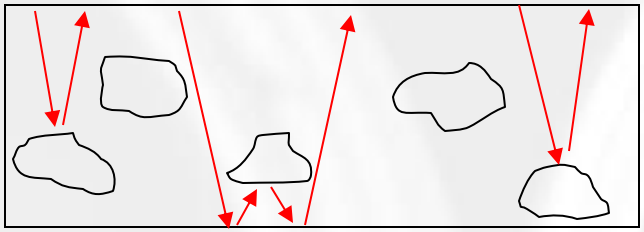
Elcometer 307

- Precision gauge for thin materials
- Extra resolution
- IE, EE and PLAS mode
- Gauge memory up to 100,000 readings / 1000 batches

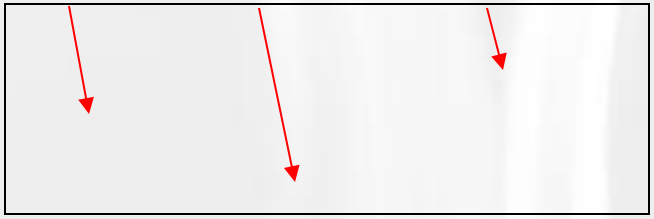
Problems



Laminations

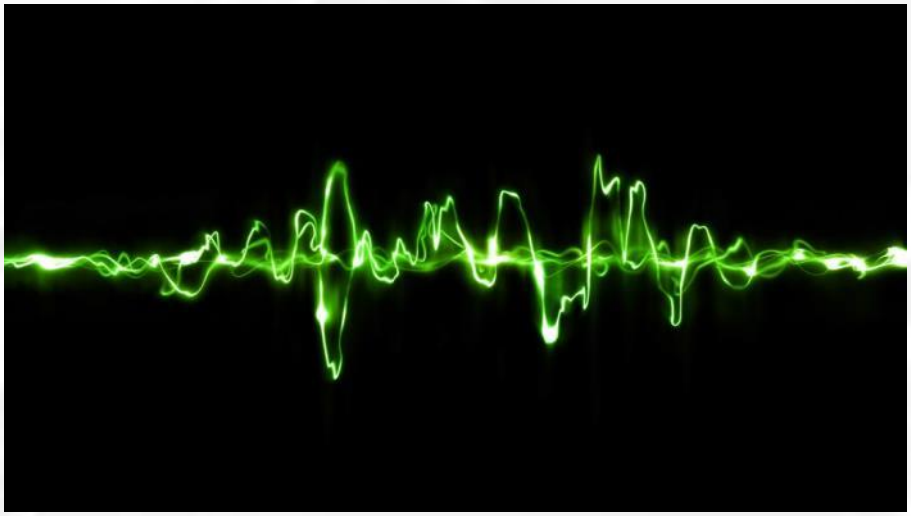


Non-homogenous



Acoustic Absorption

What have we learnt ? …



- What is ultrasound ?
- Why is it used ?
- Where is it used ?
- What is the benefit ?
- What instruments and probes are available ?
- How do you choose the correct instrument and probe ?

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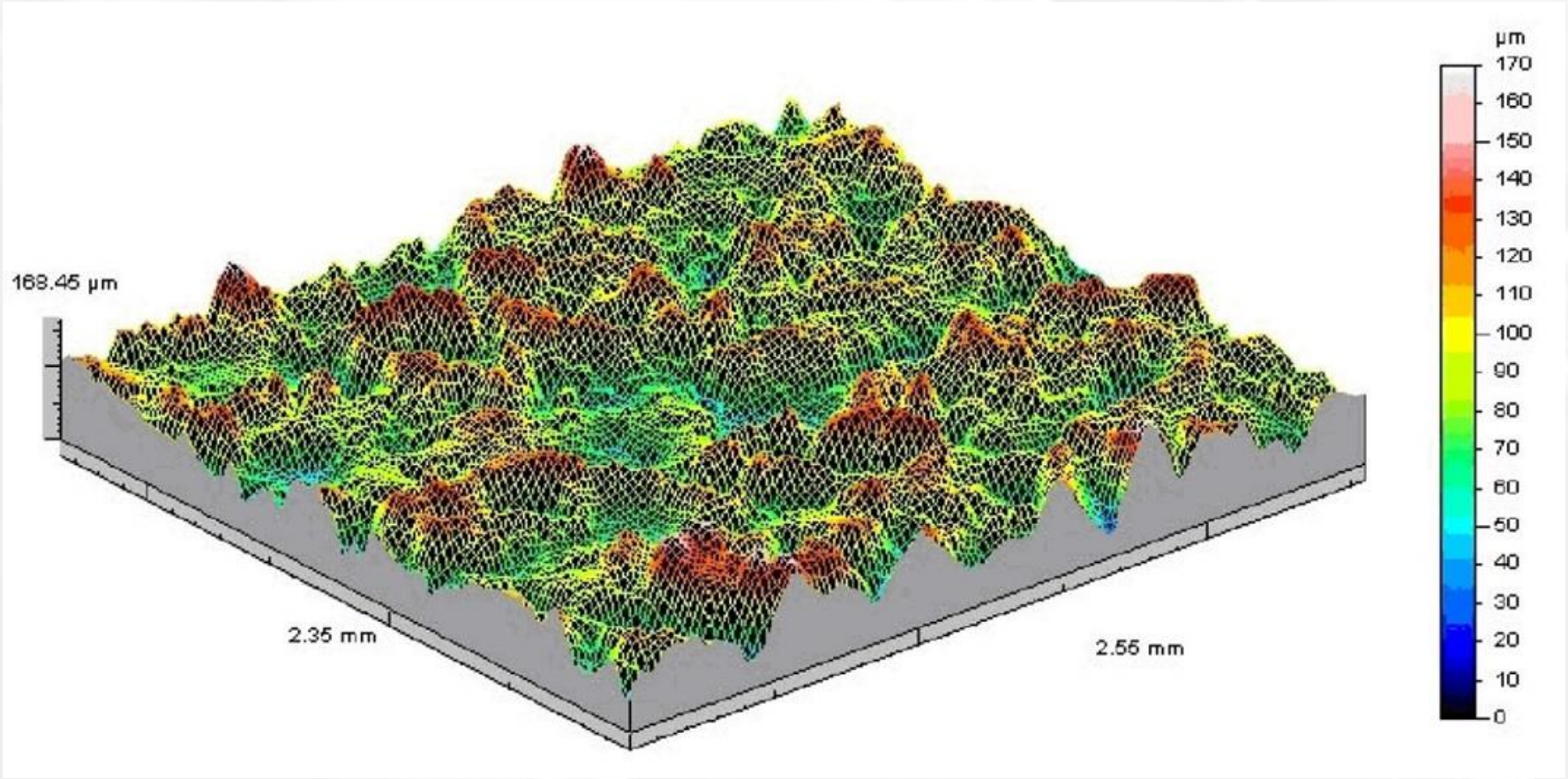
Surface Preparation



- Now we are going to measure in microns
  - What does this mean?
    - A micron is a millionth of a metre

- What size are the following items ? ….

1200µm

- What size are the following items ? ….

100µm

- What size are the following items ? ….

3µm

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ASTM D4417 Method A - Surface Comparator
Elcometer 125

- Method of Use
  - Visual or Tactile Comparison with blast cleaned surface
  - Finer than Fine, Fine, Medium, Coarse & Coarser than Coarse ratings
- Quick to use, durable, low cost per test
- Verify by visual inspection

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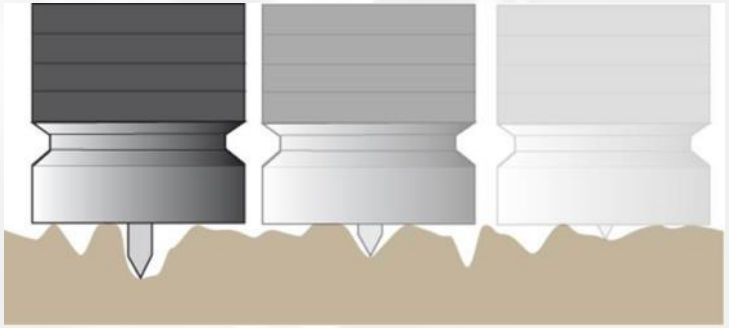
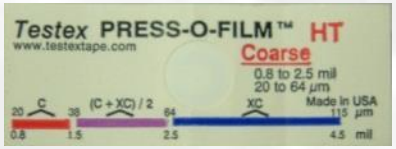
ASTM D4417 Method B – Dial Depth Gauge

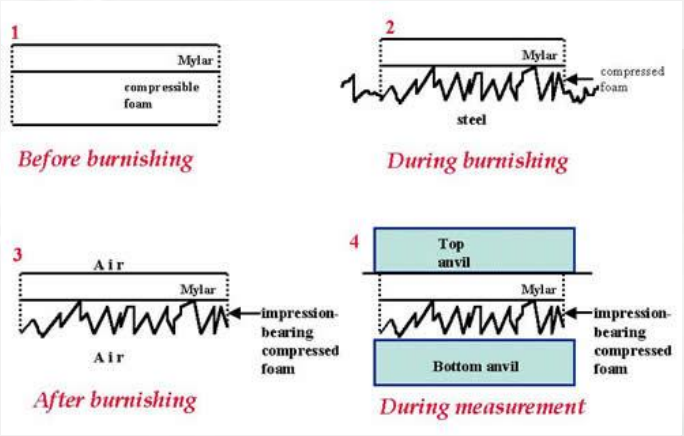
- Method of Use
  - Set zero on flat surface (Glass slide)
  - Take average of 10 readings in same area
- Quick to use, durable, low cost per test
- Calibration check against glass slide
- Verify by visual inspection of tip, field check using shims



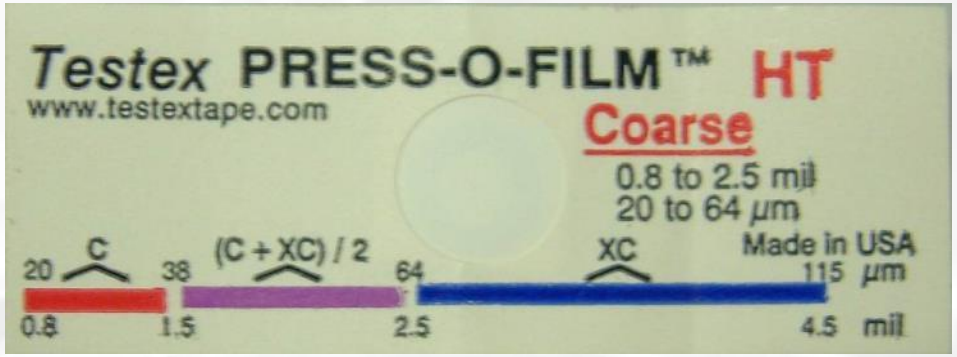
ASTM D4417 Method C – Replica Tape

- Method of Use
  - Create surface impression with 4 grades of Mylar tape
  - Take average of either 3 or 6 readings in same area
- Slow to use, high cost per test
- Calibration of snap gauge only
- Verify snap gauge using shims





Elcometer 122/124



- Testex Tape :

- There are four ranges of tape
  - Coarse minus (C-) (not used in blast profiles)
  - Coarse (C) for 20-38µm profiles
  - X-Coarse (XC) 64-115µm
  - X-Coarse plus (XC+) for profiles between 115-127µm

- Special test required for profiles between 38 and 64 microns

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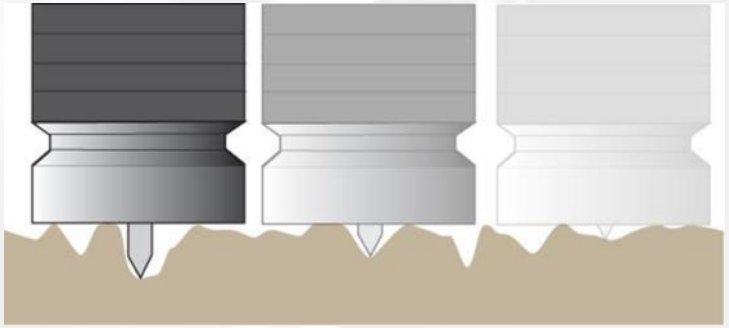
inspection equipment

ASTM D4417 Method B – Dial Depth Gauge

- Method of Use
  - Set zero on flat surface (Glass slide)
  - Take average of 10 readings in same area
- Quick to use, durable, low cost per test
- Calibration check against glass slide
- Verify by visual inspection of tip, field check using shims



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224 Options

Basic – Statistics only

Top – 150,000 readings in 2500 batches

Integral – Probe built into base of unit. One handed operation

Separate – Probe on wire

Additional maneuverability

May be used with convex surface probe for outside of pipes

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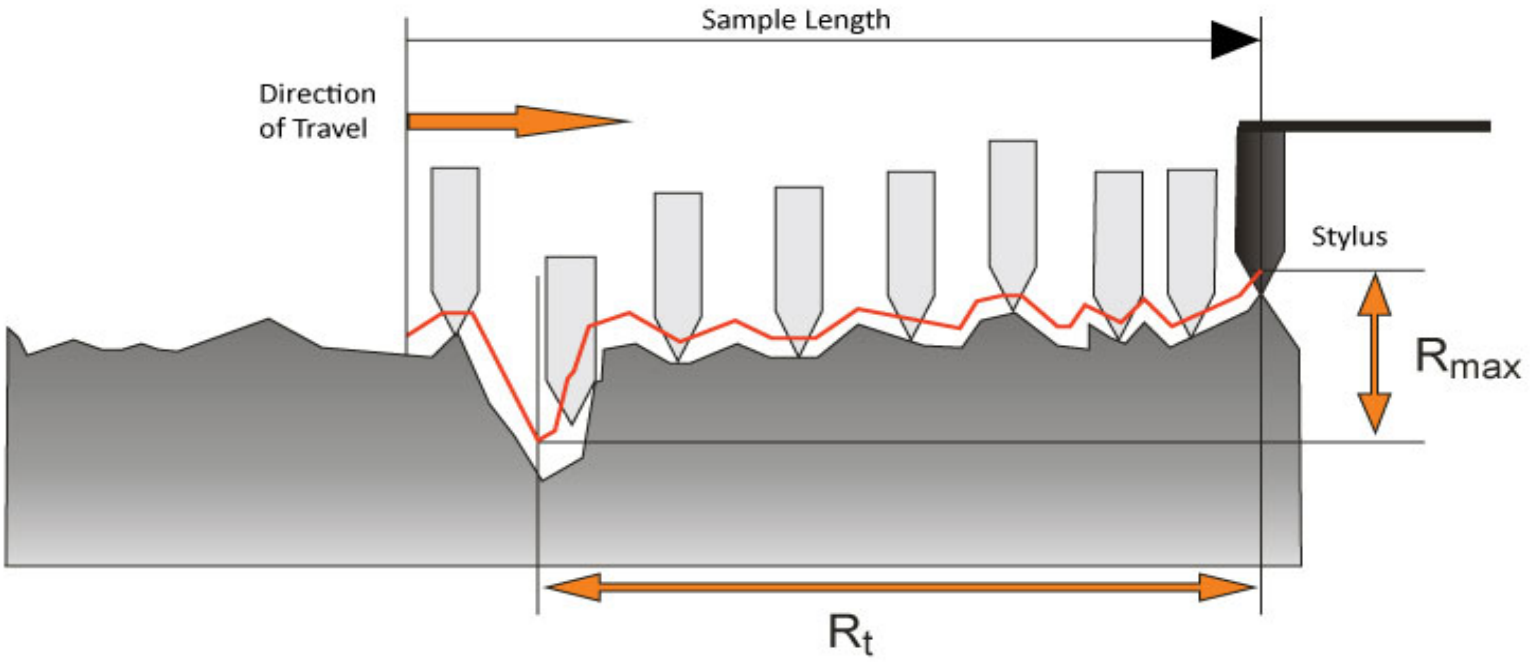
ASTM D7127 - Stylus Roughness Trace Method
Elcometer 7061

Elcometer 7061

Rmax: The greatest distance between the highest peak and lowest valley over the sampling length.
Ra: The average surface roughness over the sampling length.
Rt: The distance between the highest peak and the lowest valley within any given sampling length.
Rz: The average distance between the highest peak and the lowest valley over a number of sampling lengths.



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Chloride Salt Detection

Surface Salt Measurement Methods

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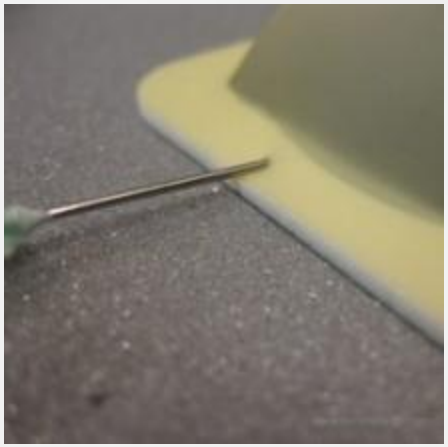
Elcometer 138 - Bresle Patch
ISO 8502-6/9

- Method of Use
  - Adhesive Patch applied to surface
  - Water injected and agitated to extract salts
  - Water removed and tested for conductivity
- Verify by conductivity
  - Temperature compensation to 25ºC
- Many ‘alternative’ patches available



Surface Salt Measurement Methods

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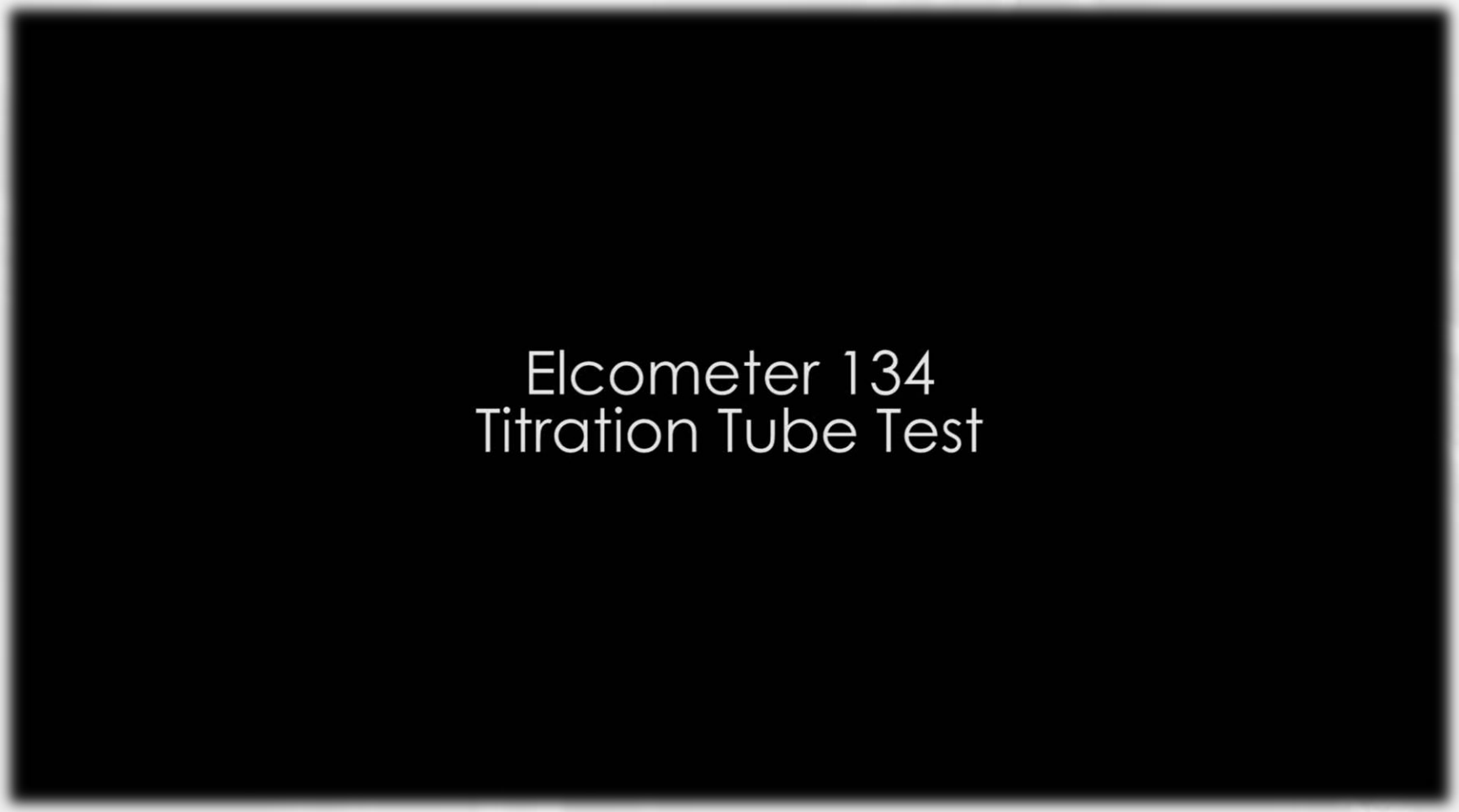
Elcometer 134 Chlor*Test

- Method of Use
  - Pour test solution into sleeve
  - Place sleeve on surface & work solution
  - Remove sleeve with solution
  - Test solution with titration tube
- Multiple concurrent tests possible

Surface Salt Measurement Methods

elcometer®
inspection equipment



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Elcometer 130

- Model S: Surface Cleanliness Measurement Mode
- Range: 0 - 25µg/cm2
- Accuracy: ±1% of the reading plus ±0.1µg/cm2
- USB data output to ElcoMaster 2.0 (live readings only)

elcometer®
inspection equipment

Elcometer 130

- Model T: Surface Cleanliness & Conductivity Measurement Modes
- Extended measuring range, multiple measuring units, user selectable statistics, memory, upper limit, batching and review graphs to the user
- USB & Bluetooth data output to ElcoMaster 2.0

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inspection equipment

- The gauges are calibrated using Calibration Verification Tile Sets in accordance with Certification Procedures

- Optional Calibration Verification Tile Sets
  Supplied as a set of 3, these tiles can be used to verify the accuracy of the gauge calibration at 0.4, 5 and 20µg/cm2.

Surface Cleanliness

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inspection equipment

- **Elcometer 130 Soluble Salt Profiler**

  - Latest technology allows mapping of salt density over paper area
  - Reveals peak salt concentration as well as average
  - Peak salt concentration areas cause localised corrosion cells – rust spotting

Surface Cleanliness

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inspection equipment

- **Elcometer 130 SSP**

  - Compatible with Android / Iphone
  - Density expressed as hotspots
  - 3D images
  - Pass / Fail salt map

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inspection equipment

134A - Salt Detection in Abrasives

- CHLOR*TEST - A™
- It is important to detect salt in abrasives to prevent salt being blasted back onto surface during cleaning
- Four tests per kit
- Simple to use

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inspection equipment

134W Salt Detection in Water

- CHLOR*TEST - W™
- 5 Tests per kit
- Place sample in clean test bottle using dropper
- Test with titration tube

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134 CSN Kit

- Detects Sulphates, Nitrates & Chlorides ions.
- Chloride test by titration tube
- Nitrate test by colour change on paper strip
- Sulphate test by colourimeter

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Other Surface Cleanliness Tests

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Elcometer 142 Dust Kit

- Assessment of quantity and size of dust particles on a surface
- Used as a pass / fail device
- Permanent record of test
- Dust comparator display board

Elcometer 142 Roller

- The Dust Tape Roller presses the Elcometer 142 Dust Tape to the surface using a controlled constant force as required by ISO 8502-3

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Elcometer 139 Amine Swab Kit

- Identifies the presence of amine blush
- Indicated by colour change of swabbed sample
- Compare to a control sample
- Lower intensity yellow in test sample indicates amines present

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Elcometer 139 Amine Chip Kit

- Identifies the presence of amine blush in paint chips
- Indicated by colour change of sample containing paint chips
- Compare to a control sample
- Lower intensity yellow in test sample indicates amines present

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Rust Standards

- Elcometer 128
  - Swedish Standard
  - British Standard
  - SSPC VIS 1
  - SSPC VIS 3

Blasting Examples ….

What have we learnt ?

- Why do we need a clean surface to paint on ?
- What contaminates the surface ?
- What instruments are available ?
- Why do they give different results ?
- Which method should be used ?
- How do we assess visual appearance ?

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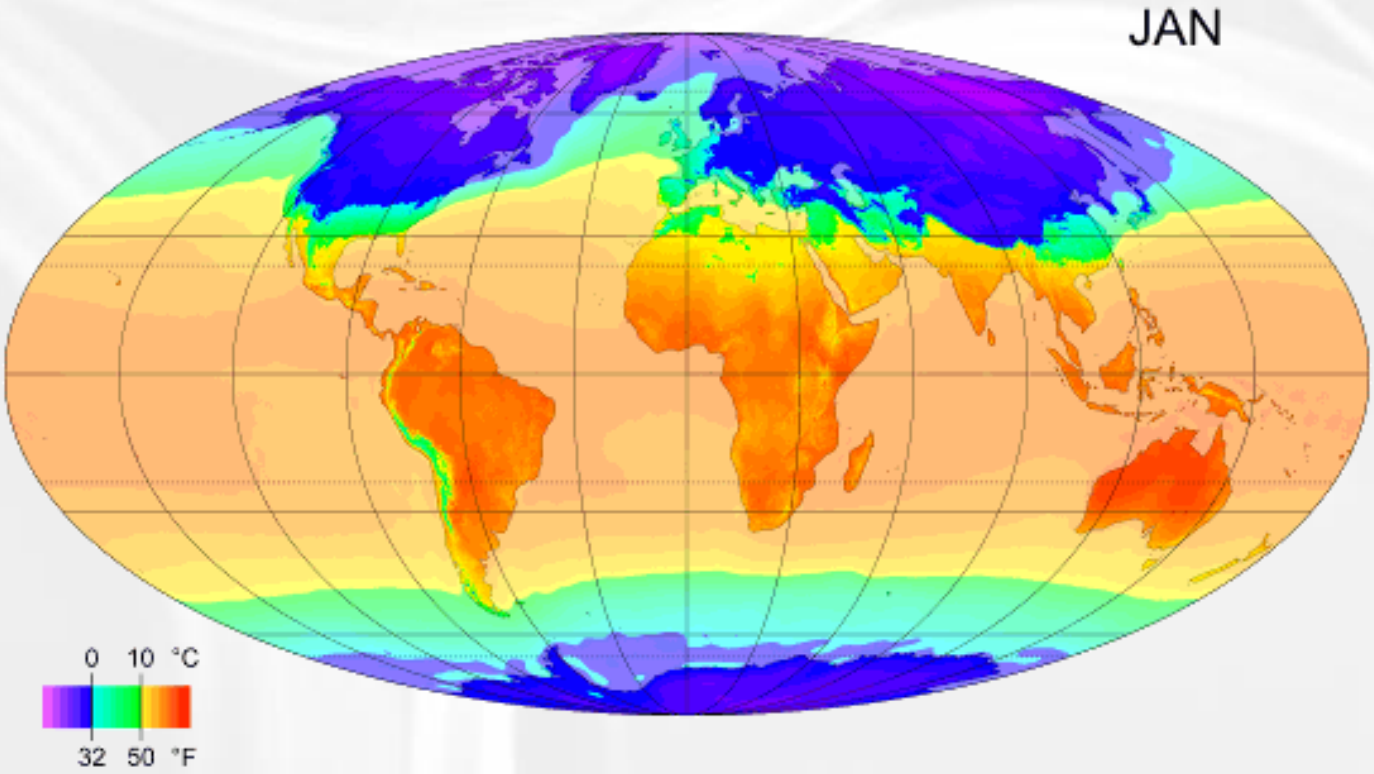
Climatic Monitoring



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What are we going to learn ?

- What climatic conditions are acceptable for painting
- What the consequences are of ignoring climatic conditions
- What the ‘dewpoint’ is and why it is important
- What instruments are available

- Coatings can only be applied in the right conditions
- Poor conditions can result in poor curing and adhesion, leading to failure
- The key parameters are
  - Relative Humidity
  - Air Temperature
  - Surface Temperature
  - Dewpoint Temperature

Relative Humidity

- A ratio of the amount of moisture in the air at a given temperature to the maximum amount of water that the air at that temperature can hold expressed as a percentage

- Saturation - 100% RH

Dew Point Temperature

- The temperature at which the moisture in the air condenses as water
  - The surface temperature must be a minimum of 3 degrees above the dew point temperature. (Delta T)

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Elcometer 116 Whirling/Sling Hygrometers

- Wet bulb temp decreases as it dries
- Dry bulb temp stabilises
  - Sling – 116A
  - Bacharach – 116C

116A

116C

Elcometer 114

- Dewpoint Calculator

Elcometer 114

- Dewpoint Calculator
  - Example
    - Dry bulb = 18°C
    - Wet bulb = 14°C

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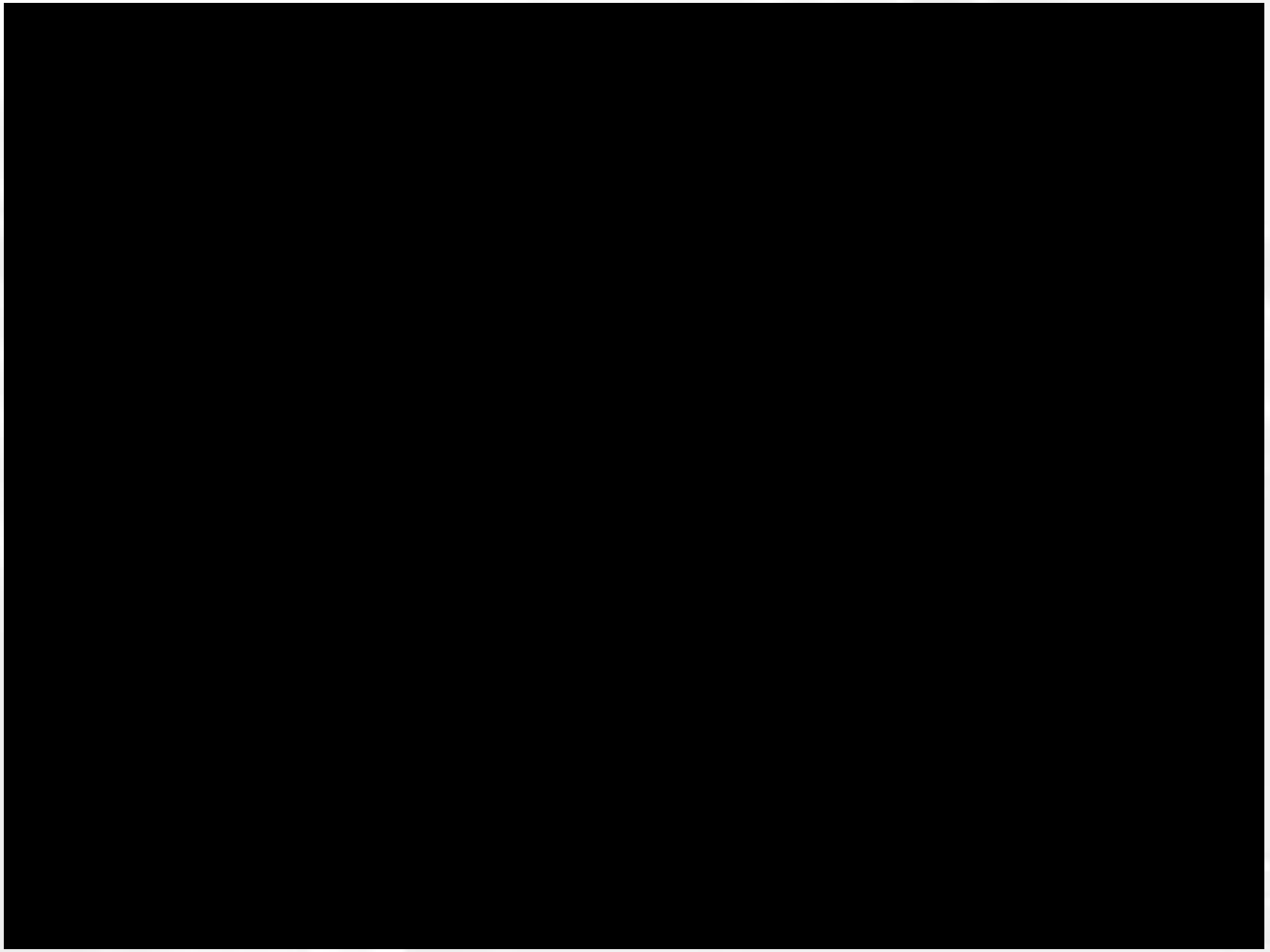

60 years of excellence
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Elcometer 319 Dewpoint Meter

- Available as standard or top models
- Measures all relevant climatic properties
- Fully compatible with ElcoMaster™

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inspection equipment

Key features

- Easy menu-driven user interface in multiple languages
- Clear illuminated display showing up to five parameters from

  - RH: % Relative Humidity
  - Ts: Surface Temperature
  - Ta: Ambient Air Temperature
  - Td: Dewpoint Temperature
  - ΔT: Difference between the dewpoint and surface temperatures
  - Tdb: Dry bulb temperature
  - Twb[1]: Wet bulb temperature

[1] Calculated Value

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Elcometer 308 Hygrometer

- Entry Level Gauge
- Designed for use in hot climates
- Displays Surface Temperature (Ts) and %RH
- Rapid measurement response
- Dust and waterproof

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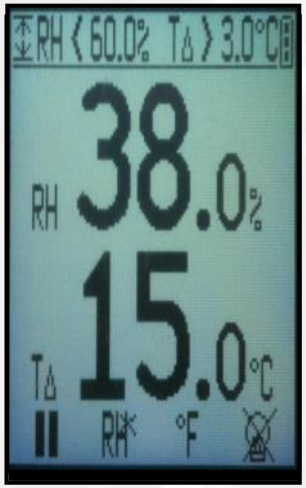
Elcometer 309 Delta T Hygrometer



- Entry Level Gauge
- Displays Delta T and %RH
- Rapid measurement response
- Dust and waterproof
- Limits on RH can be set to trigger an alarm

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Elcometer 213/2 Digital Waterproof Thermometer

- Surface Probes
- Liquid Probes
- Needle Probes
- Magnetic probes
- °C & °F Switchable
- Calibration certificate available

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Elcometer 212

- Low cost digital thermometer based on fixed K-type thermocouple
- Switchable °C & °F display

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Non-contact Thermal Measurement …

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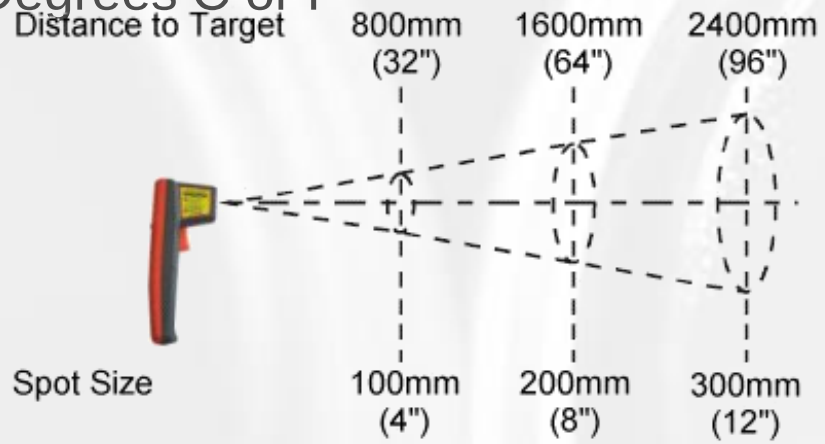
Elcometer 214L Laser IR Thermometer

- Laser target illumination
- 8:1 optics giving smaller spot size
- Degrees C or F



What Have we Learnt ?

- What climatic conditions are acceptable for painting ?
- What are the consequences of ignoring climatic conditions ?
- What is dewpoint and why is it important ?
- What instruments are available ?

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Moisture Measurement

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What are we going to learn ?

- How moisture content affect paint
- How moisture can be evaluated
- Which instruments are available to measure moisture

Moisture

- One of the most common causes of coating failure
- Porous substrates – wood, concrete, plaster, brick, etc.
- Conductivity, dielectric & electrical resistance measurement methods

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118/2 Moisture Meter

- A direct replacement for the 118
- Built in electrodes
- Also measures moisture in plaster, brick, insulation, roofing and wood by-products
- Measures up to 42% moisture

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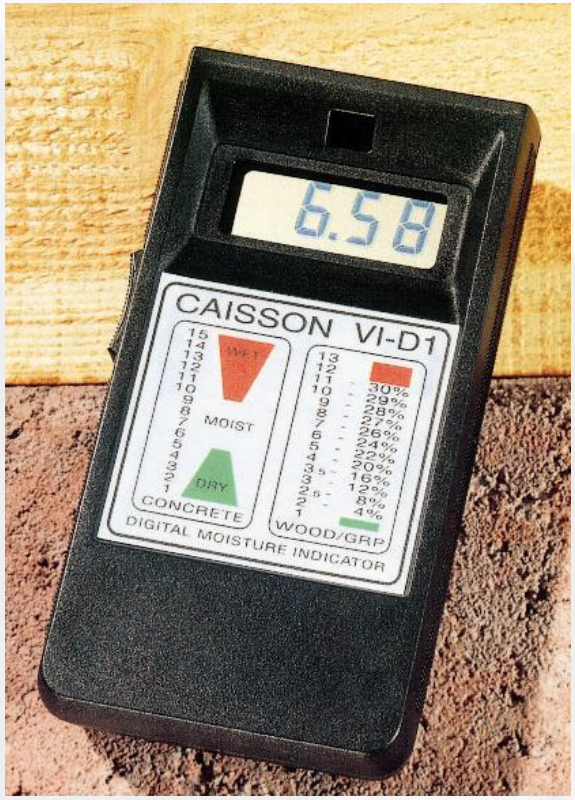

Elcometer 7420 Moisture Meter

- Non invasive
- Concrete & wood to depth of 30 mm
- High frequency signal
- Visual comparison scale

elcometer®
inspection equipment

7000 Moisture Meter

- Built in electrodes
- Two models
  - Non invasive
  - Invasive and non invasive
- Gives average moisture content
- Concrete, plaster, brick, wood etc..
- Visual red, yellow & green indications

What have we learnt ?

- How can moisture affect paint ?
- How can moisture be evaluated ?
- What instruments are available ?

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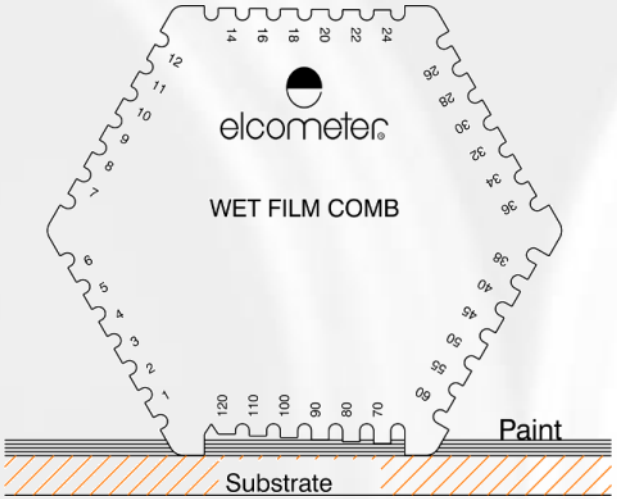
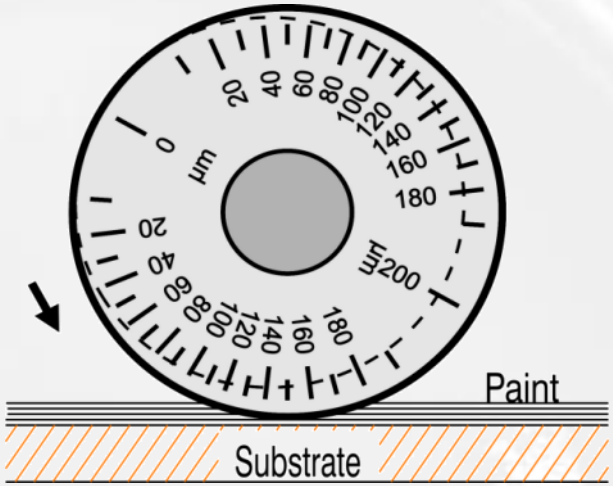
Wet Film Thickness





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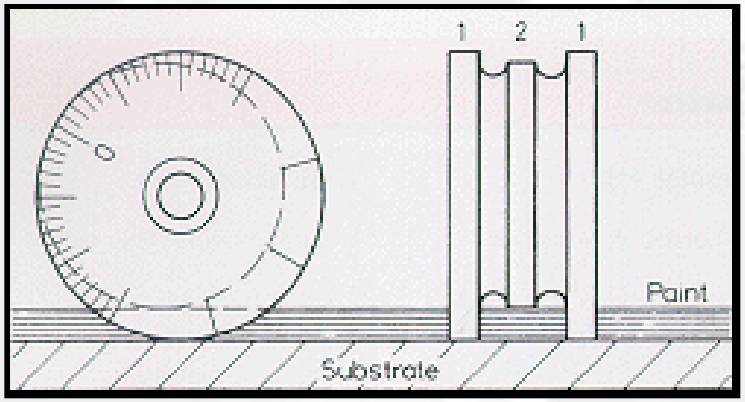
What are we going to learn ?

- Why measuring wet film thickness is of interest
- How we measure it
- What it tells us

Elcometer 3230 Wet Film Wheel

- Different scales available



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Elcometer 3230 Coil Coating Wet Film Wheel

- Eccentric centre wheel
- Start at top of scale and roll to zero
- Toothed outer wheel for slippery coatings or fast moving substrates

elcometer®
inspection equipment

Elcometer 112 & 3230 Hexagonal Wet Film Combs

- 4 different scales available
- Stainless Steel or Punched Aluminium

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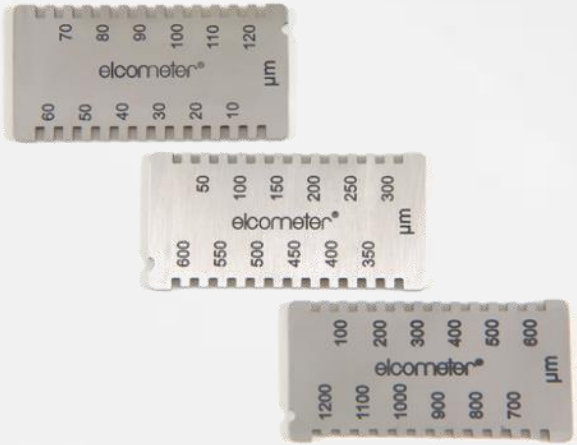
inspection equipment

Elcometer 115

- Precision formed Stainless Steel
- Certificate available
- 4 scale ranges



Elcometer 3238

- Long Edge Wet Film Comb
  - 3 scale ranges

What have we learnt ?

- Why is measuring wet film of interest ?
- How can we measure wet film ?
- What does it tell us ?

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Dry Film Thickness

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What are we going to learn ?

- Why we want to measure a dry film
- What methods are available
- How the instruments work
- How the substrate affects the measurement
- The importance of calibration
- How to speed up collection
- How to improve Data management

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Dry Film Thickness

Destructive

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Elcometer 141 P.I.G.

- Paint Inspection Gauge
  - Different cutters for different thicknesses of coating
- Illuminated Microscope
  - x50 Magnification

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121/4 Paint Inspection Gauge - PIG

- Successor to 121/3
- Available as a standard or top
- Destructive test
- Quick, versatile method of coating thickness examination
- Top version holds 3 cutting tools
- Built in 50x microscope

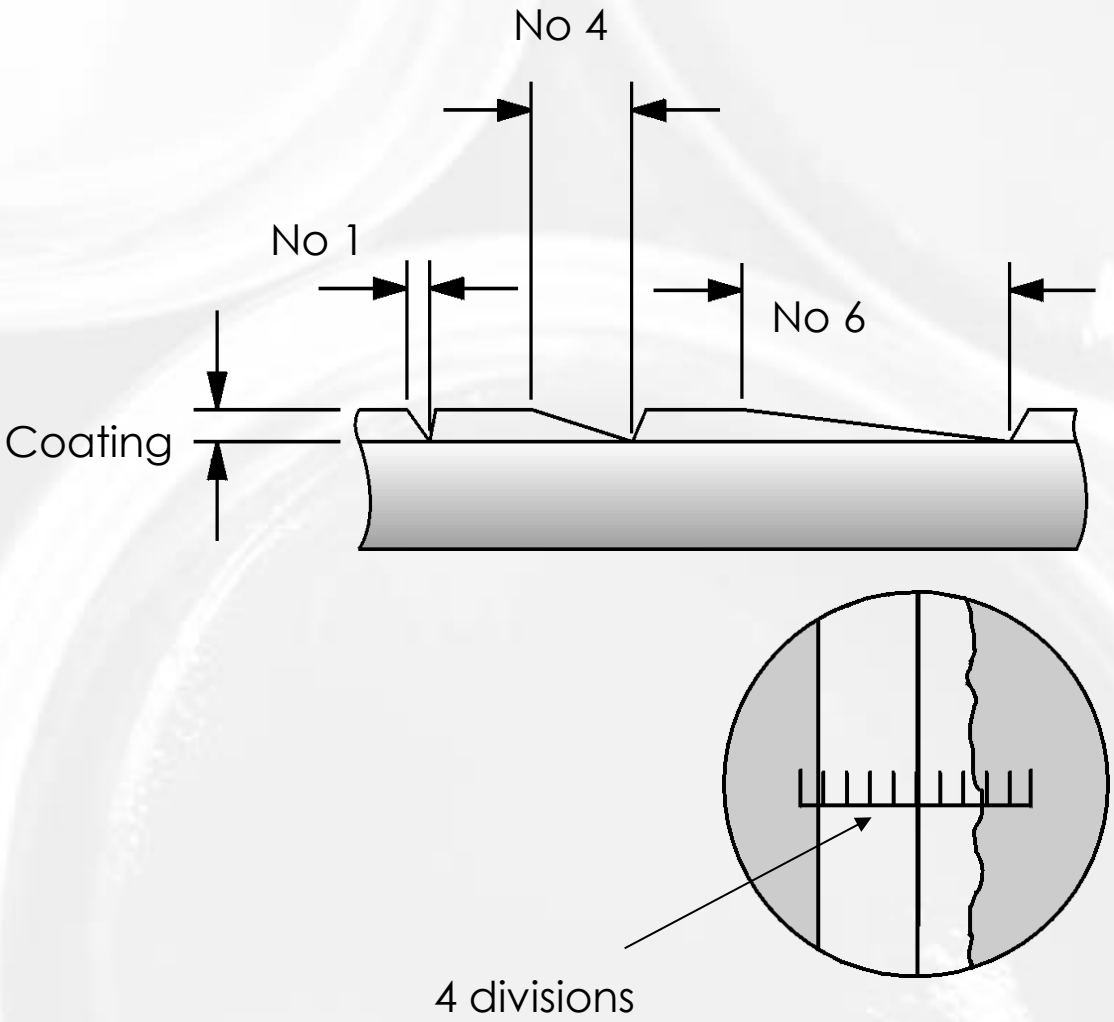
elcometer®
inspection equipment

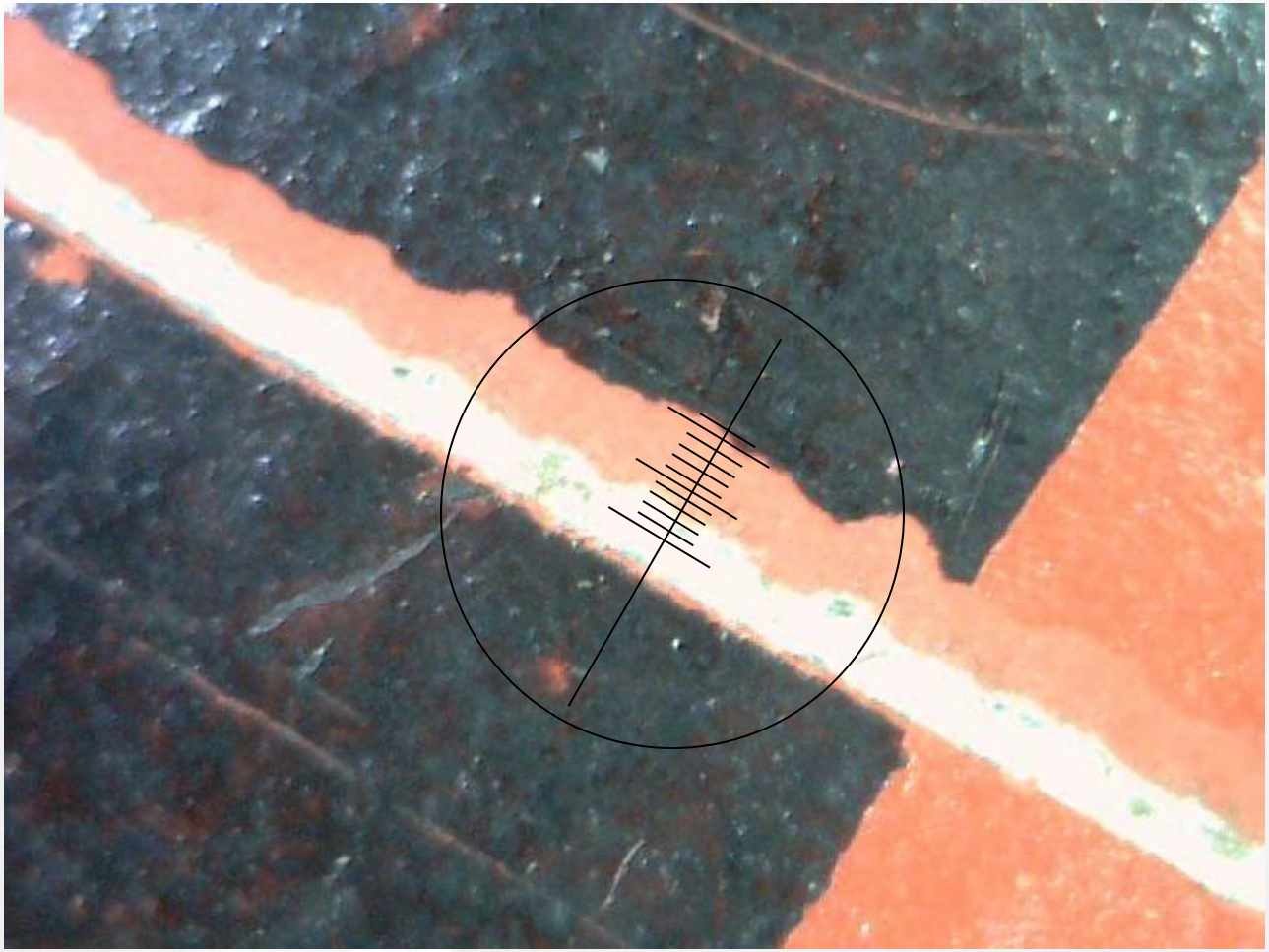
121/4 Paint Inspection Gauge - PIG

- Built in bright LED light
- Small and compact
- Rotating carousel (top)
- Rugged and durable
- Top can be used for cross hatch test (Top)

P.I.G. Operation

- Sectional View of Cuts
- View Through Microscope
- Count number of divisions and multiply by cutter factor





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Mechanical Coating Thickness Gauges

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Elcometer 211

- Known as the Banana Gauge
- ± 5% accuracy
- “Fixed” calibration
- Metric & Imperial Scale options
- Used in hazardous environments
- Can be used underwater

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Elcometer 157

- Simple pull-off gauge
- ± 15% accuracy
- 3 scales on body
- Used as an indicator of number of coats

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Electronic Coating Thickness Gauges

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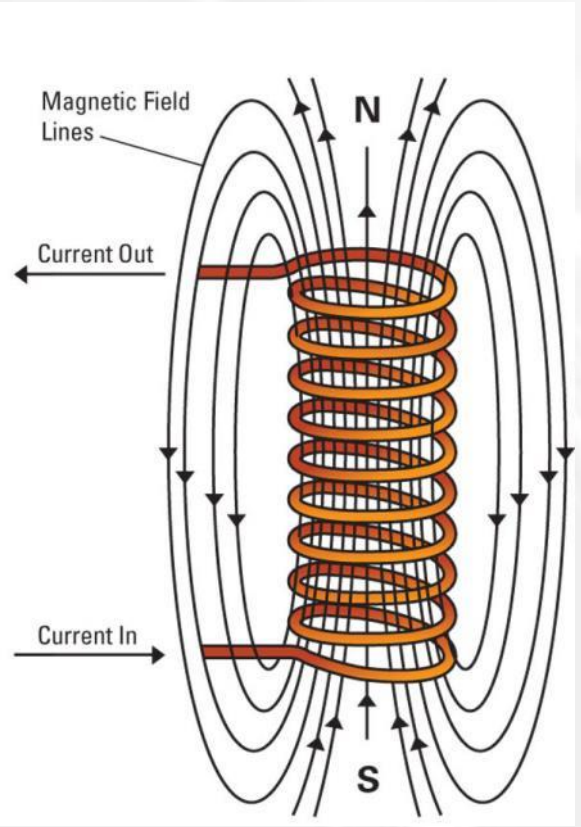
First Principles ….

- Electronic gauges can only measure on metallic substrates
- If the substrate is magnetic (ferrous) then the gauge uses Electromagnetic Induction
- If the substrate is non-ferrous (non magnetic) then the gauge uses Eddy Current technique



Electromagnetic Induction

- Coils inside the gauge generate a low frequency magnetic field.
- The variation of the field is proportional to the distance between the probe tip and the substrate
- A measurement coil measures the magnetic field

Eddy Current

- Coils inside the gauge generate a high frequency magnetic field.
- These induce Eddy currents into the substrate
- The strength of the Eddy currents are proportional to the distance between the probe and base material
- The Eddy current magnetic field strength is then measured

Discuss whether the following can be measured …

- Paint on lead
- Paint on plastic
- Paint on iron
- Paint on wood
- Gold on copper

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456C Coating Thickness Gauge

- Robust ergonomic design
- USB and Bluetooth data output to ElcoMaster ™ 2.0
- Accurate to 1-3% of range
- 70+ readings per minute

Key Features

elcometer®
inspection equipment

Fast reading rate of more than
70 readings per minute

Dust and water resistant
rugged design to IP65

Specialised probes to meet a
wide range of applications

Secure probe connection for
improved durability

USB and *Bluetooth*® data output
to ElcoMaster 2.0 software

Integral and separate gauges to measure
coatings up to 30mm thick

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To select the correct instrument for the job you need to know…

- What the substrate is made of
- What the coating is
- What thickness the coating is
- Integral or separate probe desired
- Data storage required ?

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Elcometer 456C

- Ferrous, Non-Ferrous and Dual FNF
  - Other Options
    - Entry Level (Integral gauges only)
    - Basic
    - Standard
    - Top
  - Basic now features Bluetooth for single reading transfer
  - Standard & Top have USB and Bluetooth output
  - Standard 1500 readings in 1 batch
  - Top 250,000 readings in 1500 batches

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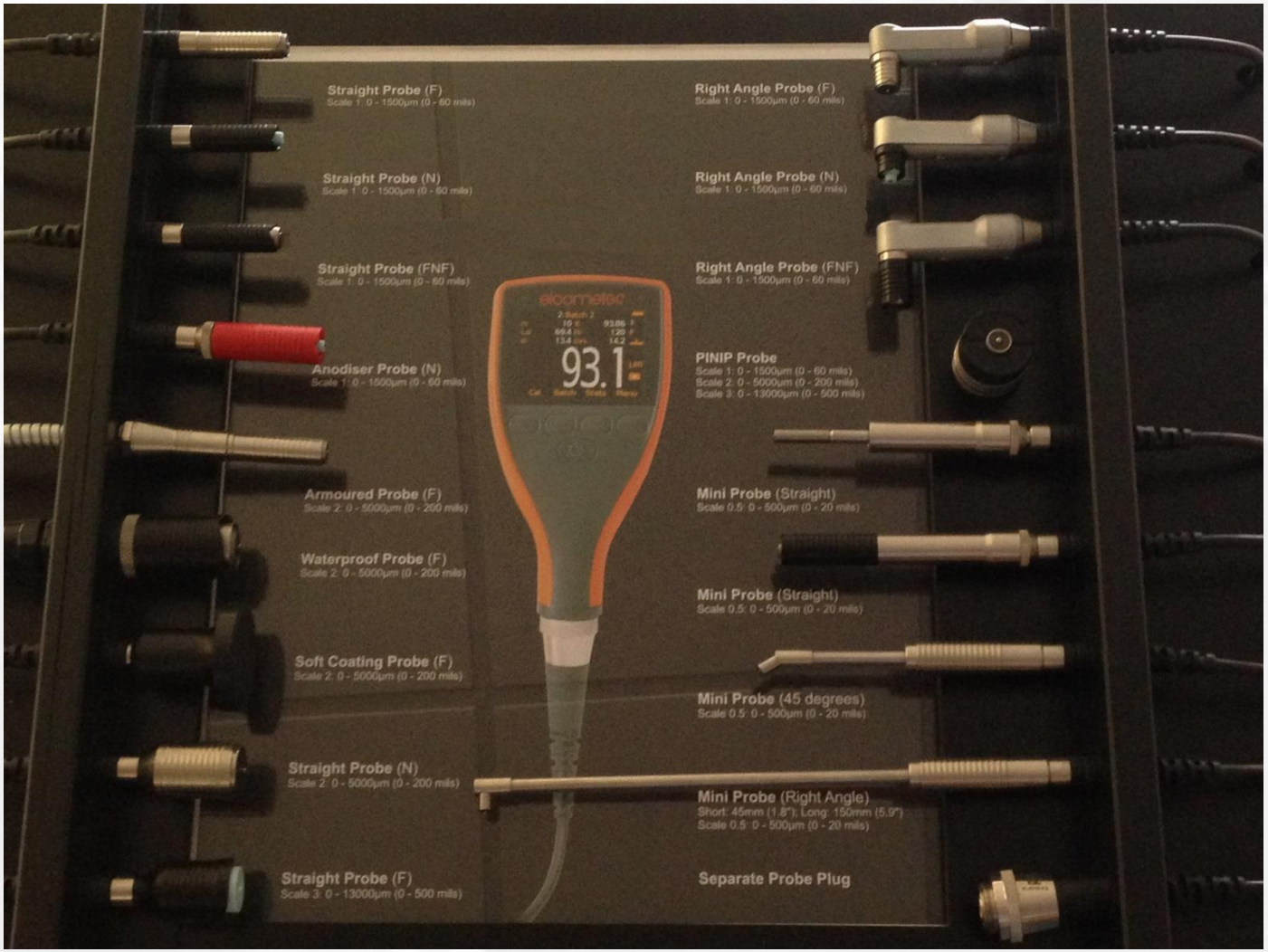

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Scanning Probe

- A new 456C probe for scanning a coated surface
- Scan an area then lift the probe to display :
  - Average coating thickness
  - Maximum coating thickness
  - Minimum coating thickness

Scanning Probe

- Readings can be displayed on a run graph
- Auto repeat mode takes & stores data every 0.5 secs
- Snap on replaceable cap
- 40% faster when used with SSPC PA2
  - Fixed batch size (5)
  - Counted average (3)

Elcometer 355

- Probe Module fitted in rear of gauge
- 1% Accuracy – good accuracy due to dual microprocessors
- µP's in probe module and in gauge
- F and N modules
- Range of probes

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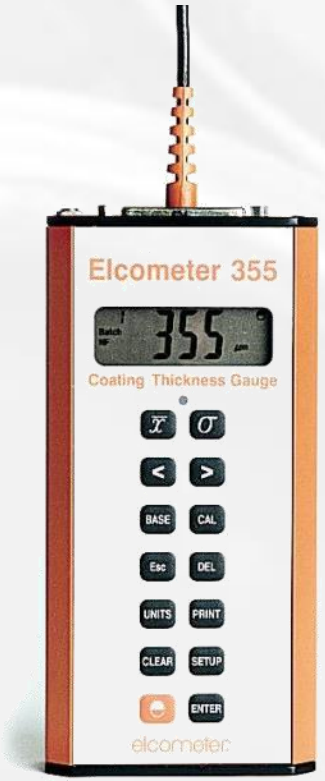
Elcometer 355 Standard

- Memory for 5000 Readings
- 25 pre-set batches
- Statistics
- Serial & Parallel O/P



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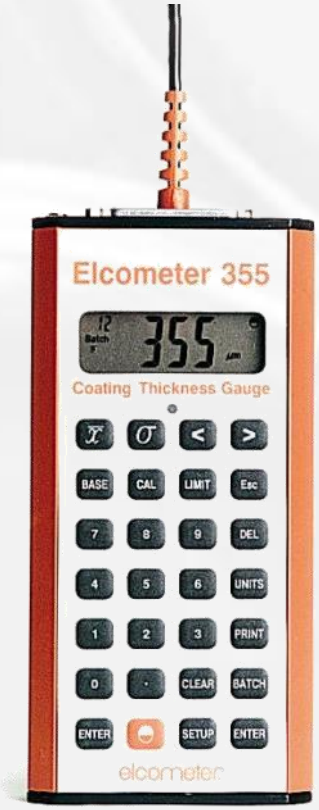
Elcometer 355 Top

- Memory for 10,000 readings
- 200 batches
- Serial & Parallel O/P
- Date/Time Stamp
- Statistics



What have we learnt ?

- Why do we measure a dry film ?
- What methods are available ?
- How do the instruments work ?
- How does the substrate affect the measurements ?
- Why is calibration so important ?
- How can we speed up data collection ?
- What can we do to manage the data more efficiently ?

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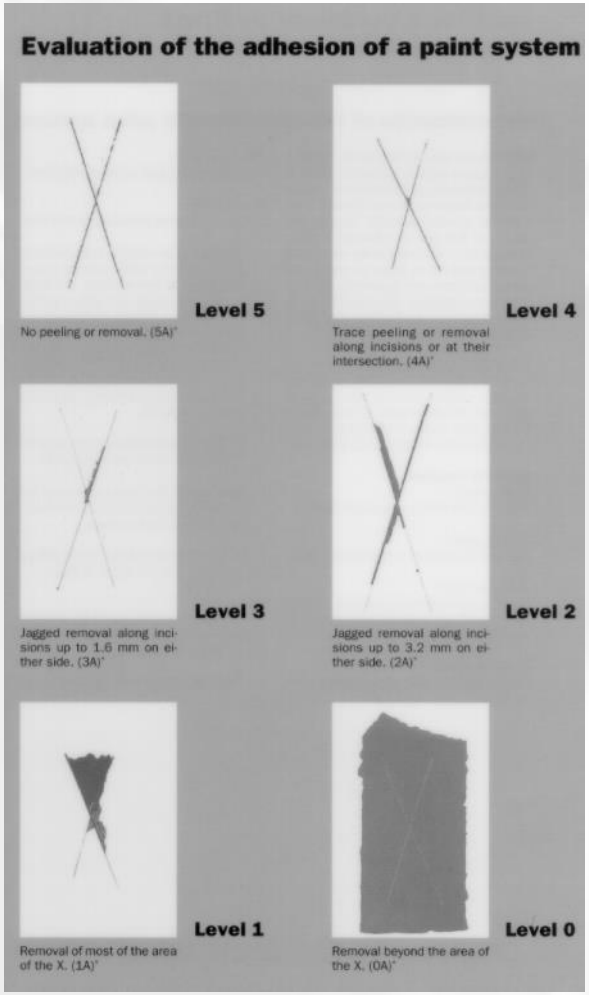
Coating Adhesion

- What are we going to learn ? …

  - What methods are available to test coating adhesion
  - What instruments are available
  - How you interpret results
  - Why they can give different results
  - Which method do we use

Method selection

- Cross Cut
  - Fast low cost
  - Flat surfaces only
  - Up to 250 µm (10 mil)
- Pull Off
  - Use dollies
  - Slower due to time for adhesive cure
  - Flat & Curved surfaces



St Andrews Cross

- Assessment chart
- Use for exposure and accelerated stress testing of coatings
- Fast low cost method
- Maximum thickness 125 µm

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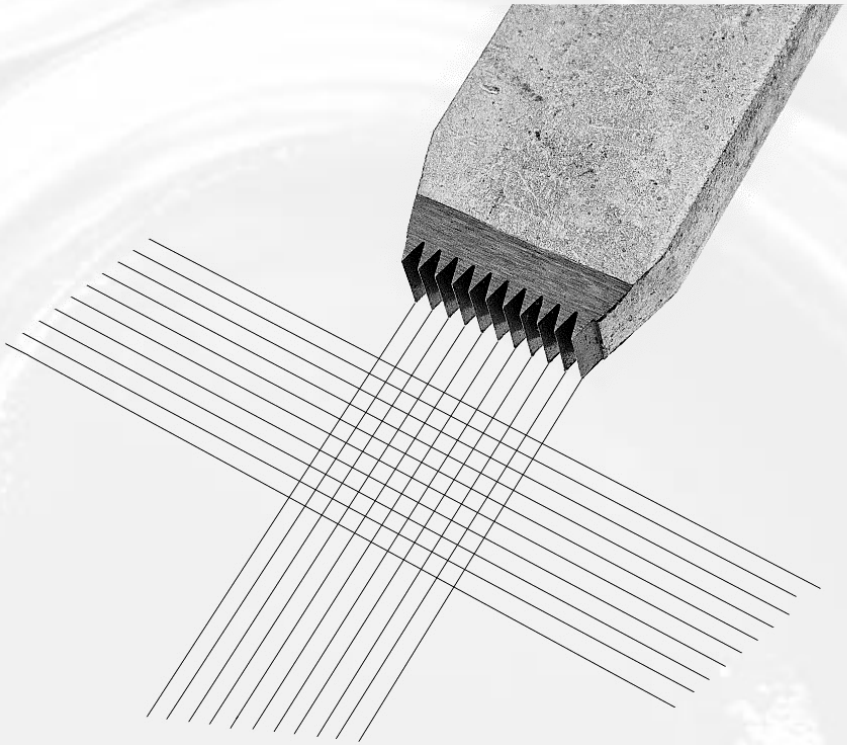
Elcometer 1540 Cross Cut Tester

- 1 mm cutter 11 teeth
- Gives 100 squares
- Easy to assign adhesion percentage



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Elcometer 107 Cross Hatch Cutter Kits

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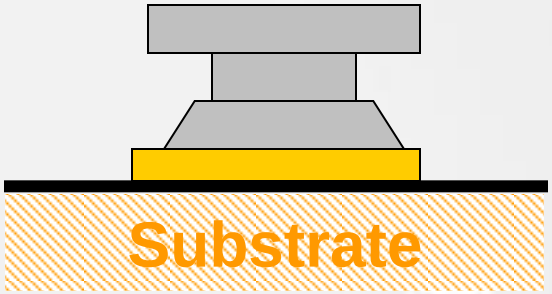
inspection equipment

Elcometer 1542 Cross Hatch Adhesion Tester

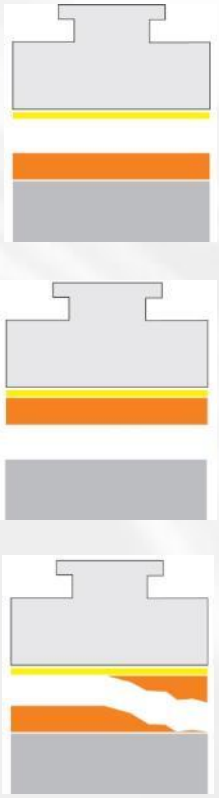
- Ideal for test panels
- Wheeled carriage for greater stability

Pull-off Methods - Common Issues

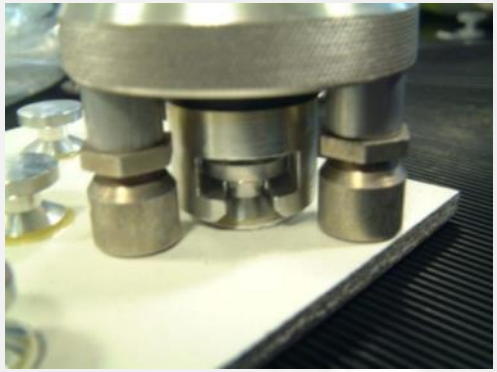
- Use adhesive to attach dolly to coating
- Measure force to remove coating
- Ensure dolly face is rough for good contact
- Choice of adhesive



Adhesion Test Failure Modes



- Glue Failure
  - Failure of the applied adhesive
  - Not an Admissible Test unless failure occurs above test specification
- Adhesive Failure
  - Coating to substrate or undercoat mechanical bond failure
  - Admissible Test
- Cohesive Failure
  - Coating chemical bond failure
  - Admissible Test




Adhesive Failure
Partial adhesive Failure
Cohesive Substrate Failure
Glue Failure

Types of Pull-Off Testers

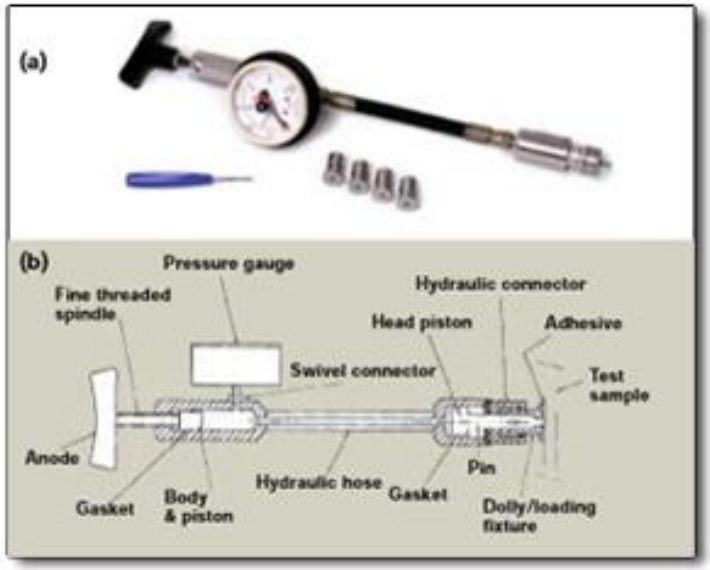
- ASTM Type II - Fixed Alignment Manual Adhesion Tester

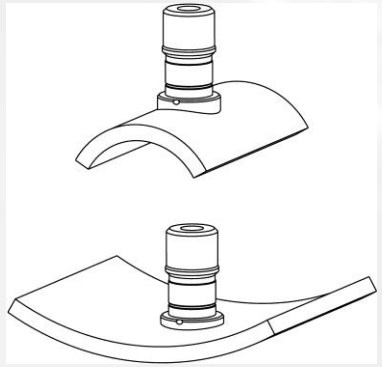
Mechanically load applied by Compressed Spring

Mechanically load applied by Compressed Washers

Types of Pull-Off Testers

- ASTM Type III - Self-Alignment Hydraulic Adhesion Tester
  - Operated by manually applied hydraulic pressure
  - Often called Push-Off or HATE Testers
  - Available with Flat or Curved dollies

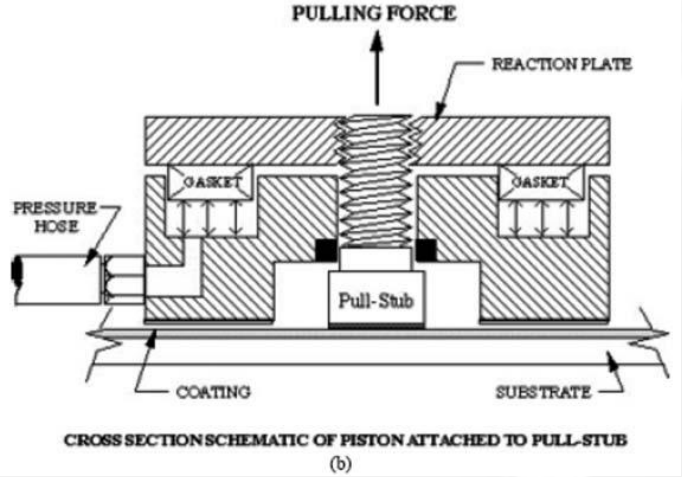




Curved Dolly Options

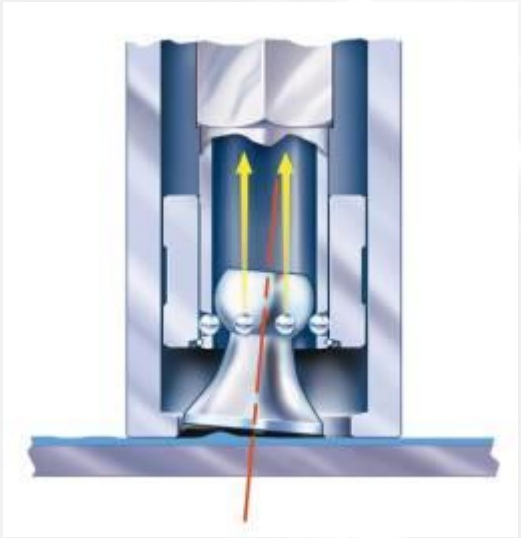
Types of Pull-Off Testers

- ASTM Type IV - Self-Alignment Pneumatic Adhesion Tester
  - Operated by pneumatically applied pressure



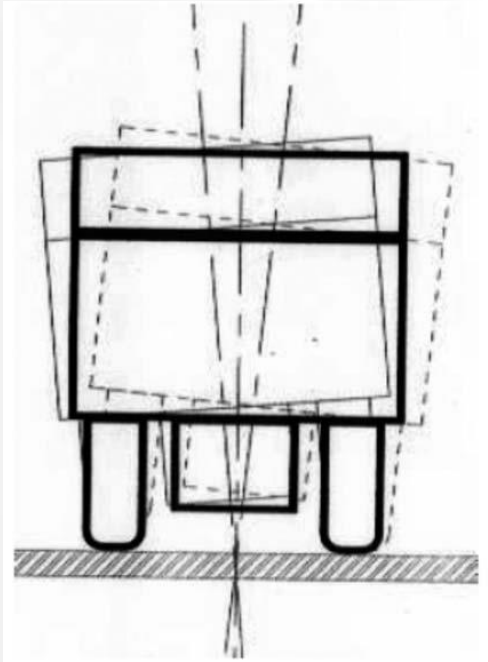
Types of Pull-Off Testers

- ASTM Type V - Self-Alignment Adhesion Tester
  - Operated by manually or automatically applied hydraulic pressure
  - Undesired Shear Load can occur under certain conditions



Types of Pull-Off Testers

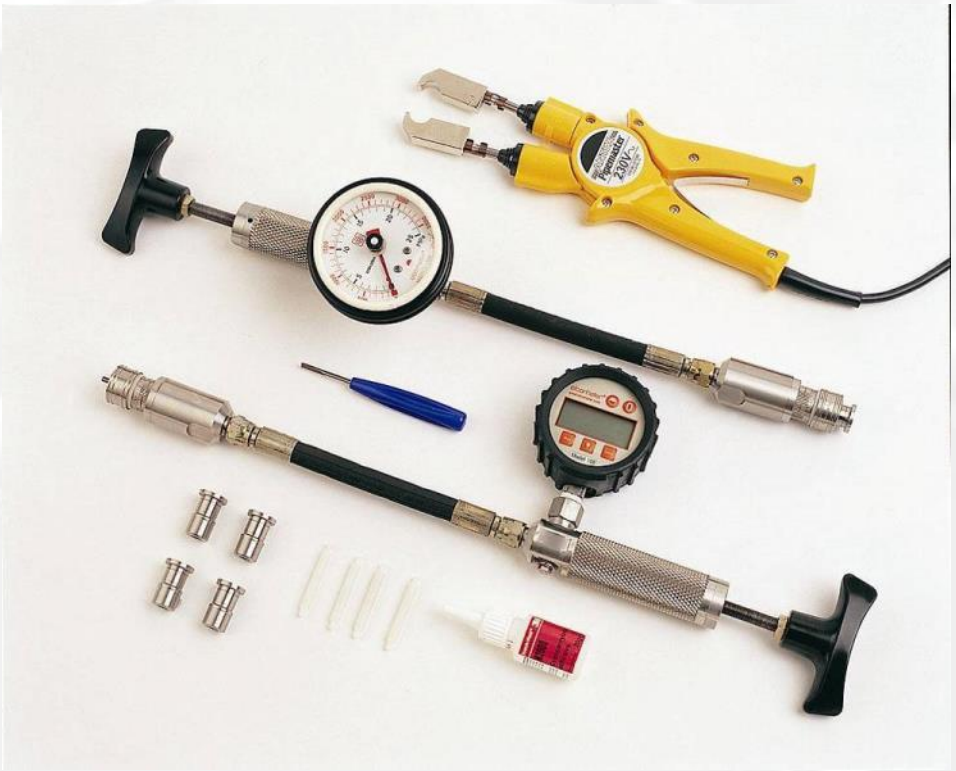
- ASTM Type VI - Self-Alignment Adhesion Tester
  - Operated by manually or automatically applied Hydraulic Pressure
  - Features ‘self- aligning’ test head
  - Often called PAT Testers



- Elcometer 106 - ASTM type II - Pull-off Adhesion Tester
  - 5 Scales
  - 2 types – hand wind or ratchet
  - Ideal for general applications

Elcometer 108 ASTM type III -Hydraulic Adhesion Tester

- 0 - 18MPa range
- Dolly has a hole through the centre
- Through hole force pushes dolly away from surface
- Curved dollies available
- Supplied with heated tongs to clean dolly
- Designed for use on pipework and cylindrical surfaces



Elcometer 506 – ASTM type V -Analogue Adhesion Tester

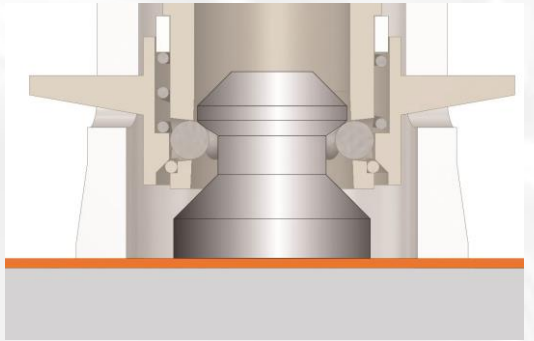
- Manual hydraulic operation
- Measures up to 50MPa
- Compatible with 14.2, 20 & 50mm dollies
- 25MPa & 50MPa range display
- Course adjustment screw

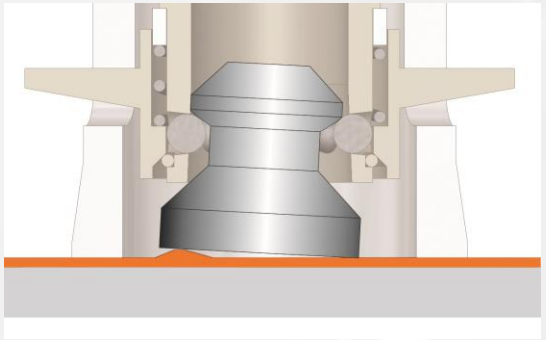
Elcometer 506 Digital Adhesion Tester

- Manual hydraulic operation
- Measures up to 50MPa
- Compatible with 14.2, 20 & 50mm dollies
- Dolly size selection button auto-ranges
- Course adjustment screw

Elcometer 506 Adhesion Gauge

- Designed to orientate load to minimise shear effects
- Digital and Analogue versions available
- Actuator skirt options available for thinner substrates
- Usable on metal, wood, concrete and other substrates
- Available with field verification unit





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Elcometer 506 Adhesion Tester

- Different ‘skirts’ available
- Large skirt for 50mm dolly
- Narrow skirt for thin substrates
- Standard skirt for 14.2 & 20mm

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Elcometer 510 - ASTM type V -Automatic Adhesion Gauge

The Model Range

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- Elcometer 510:
  - Model S
    - An entry level gauge
    - Battery Powered
    - Defined pull rates
    - 60 reading memory
    - USB output to ElcoMaster 2.0;

The Model Range

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inspection equipment

- Elcometer 510:
  - Model T
    - Battery and Mains Power
    - USB & Bluetooth (Android and iPhone, iPad, iPod)
    - Up to 60,000 readings in 2,500 alphanumeric batches
    - Cohesive/ adhesive attribute information,
    - Pull rate graph
    - Pull to Limit setting

510 kit

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Elcometer 510 – Key Features

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Variable pull rates 0.1 – 1.4MPa/s (15-203psi) to meet national and international standards

Smooth and continuous pressure application for consistently repeatable results

MPa, psi, N/mm² and N

Store up to 10,000 readings, 2,500 alpha numerical batches with attributes and pull rate graphs

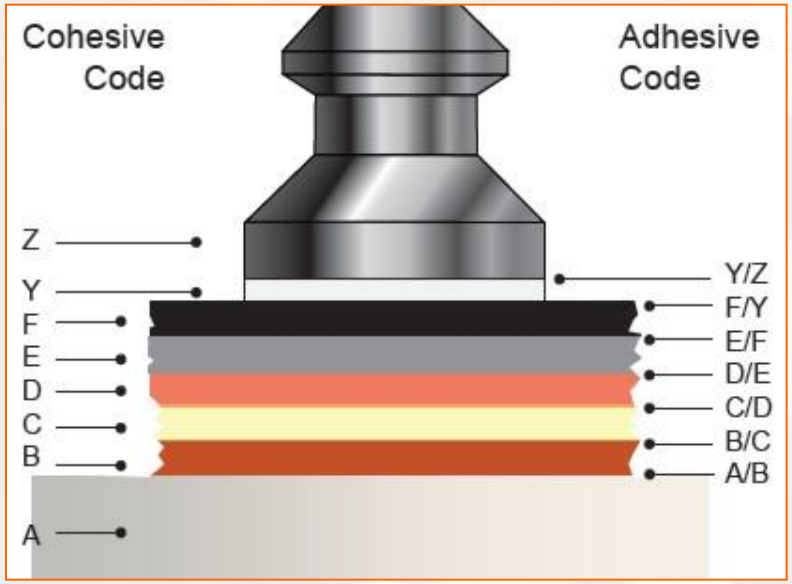
Pull to maximum or to a pre-defined limit (non-destructive test)

10mm dolly: (14400psi)	<100MPa
14.2mm dolly: (7200psi)	<50MPa
20mm dolly: (3600psi)	<25MPa
50mm dolly: (580psi)	<4MPa

Optional thin substrate skirt

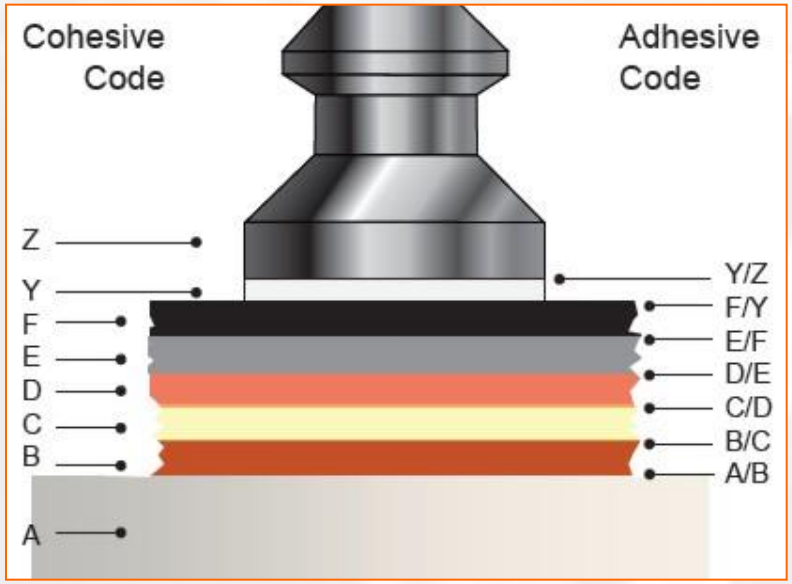
Bluetooth® wireless technology | ElcoMaster™ 2.0 data management software | ElcoMaster™ mobile app | Suitable for use in Cloud Computing | Made for iPod iPhone iPad | Android™

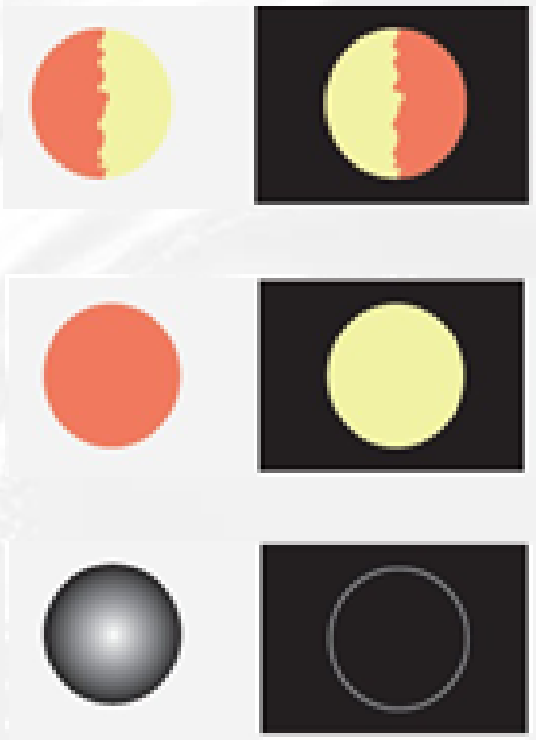
Cohesive / Adhesive Failure Attributes



Cohesive Failure Layer[d]		Adhesive Failure Layers	
Code	**Description**	**Code**	**Description**
A	Substrate	A/B	Substrate & Layer 1
B	Layer 1	B/C	Layer 1 & Layer 2
C	Layer 2	C/D	Layer 2 & Layer 3
D	Layer 3	D/E	Layer 3 & Layer 4
E	Layer 4	E/F	Layer 4 & Layer 5
F	Layer 5	F/Y	Layer 5 & Glue
Y	Glue	Y/Z	Glue & Dolly

Cohesive / Adhesive Failure Attributes





- What have we learnt ? …

  - What methods are available ?
  - What instruments do we offer ?
  - How do you interpret the results ?
  - Why can different instruments give different results ?
  - Which instrument and methods should we use ?

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Porosity Detection in Coatings

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inspection equipment

- What are we going to learn ? …
  - What holiday detection is
  - What methods are available
  - What instruments we can offer
  - How to operate the units safely

Definition of Porosity

A flaw or defect in the cured coating that reduces the effectiveness of the coating as a protection against corrosion.

Porosity Test Methods

- Low Voltage (Wet Sponge Method)
- High Voltage (DC / Pulsed DC) Holiday Detection
  - (Also known as spark testing)

- ONLY USE ON NON CONDUCTIVE COATINGS !!!

Elcometer 270 Pinhole Detectors

- Low Voltage Method
- Wet Sponge Pinhole Detection (wet sponge & squeeze out)

Summary - 270

- Suitable for non-conductive coatings on a conductive substrate
- 9V for coatings up to 300 µm
- 90V for coatings up to 500 µm

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High Voltage Holiday Detection

High Voltage Holiday Detection is a method of locating flaws in electrically insulating protective coatings on conductive substrates.

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Pulsed DC & Continuous DC Explained

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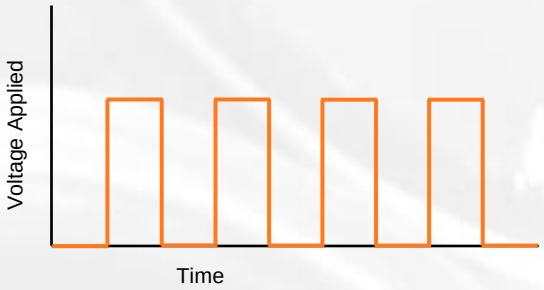
Pulsed DC

The Elcometer 280 operates using this principle



Continuous DC

The Elcometer 236 and 266 operate using this principle

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Elcometer 266

- Continuous DC
- 5kV, 15kv & 30kv options
  - Interchangeable handles
- Auto/Digital voltage and sensitivity settings
- Safety features
  - For operator
  - For coating

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Elcometer 266 – Operator Safety

- Rugged and waterproof to IP65
- Safety pressure switch on handle
- Current limiting
- Specialised extended ribbing
- 12V cable from base unit to handle
- Two handed rubber adaptor

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Elcometer 266 – Coating Safety

- Current limiting
- Voltage Calculator with digital standards library
- Integrated jeep tester

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Elcometer 266

- Accessory adapters for
  - Tinker and Rasor
  - Spy
  - PCWI
  - Legacy Elcometer equipment

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Elcometer 266

- Probe Options
  - Band Brush
  - Right Angle Brush
  - Right Angle Conductive Rubber
  - Internal Pipe Brush
  - External Pipe Rolling Spring

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Elcometer 280

- Pulsed DC
- 0.5 – 35kV range
- Standard Gauge or Top Kit
- Trailing earth lead
- Auto/Manual digital voltage setting

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Elcometer 280 Safety features

- Operator
  - Safety switch
  - Specialised extended ribbing
  - Energy limit
- Coating
  - Voltage calculator with digital standard library
  - Integrated jeep tester

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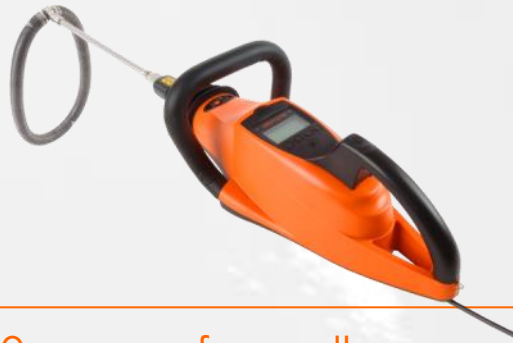
The 2 Key Advantages of the Pulsed DC System

- The pulsed DC system does not need the direct metal-to-metal ground contact and therefore can be used with a trailing lead.

- The Elcometer 280 can be used to test for holidays over slightly conductive coatings, or dirty or damp surfaces up to 25mm thick



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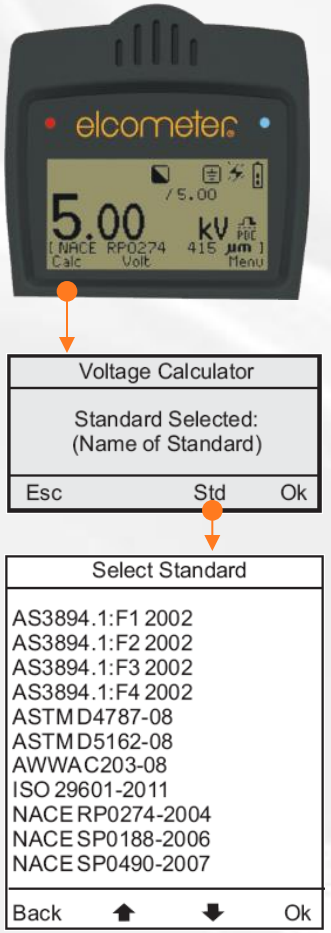
The Voltage Calculator (266 & 280)

This function automatically calculates the test voltage using the specified international standard and the specified dry film thickness.

1. Switch the gauge on
2. Select the required standard from the list available
3. Adjust the dry film thickness to the required value
4. Press Ok to set the instrument voltage to the calculated value



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Accessories for Elcometer High Voltage Detectors

A wide range of electrodes and accessories is available :

- Band Brush Probes
- Wire Brush Probes
- Internal Pipe Brush Probes
- External ‘C-type’ Brush Probes
- External Pipe Rolling Springs
- Conductive Rubber Probes
- Grounding Mats

- What have we learnt ? …

  - What is holiday detection ?
  - What methods are available ?
  - Which instruments can we offer ?
  - How do we operate the instruments safely ?

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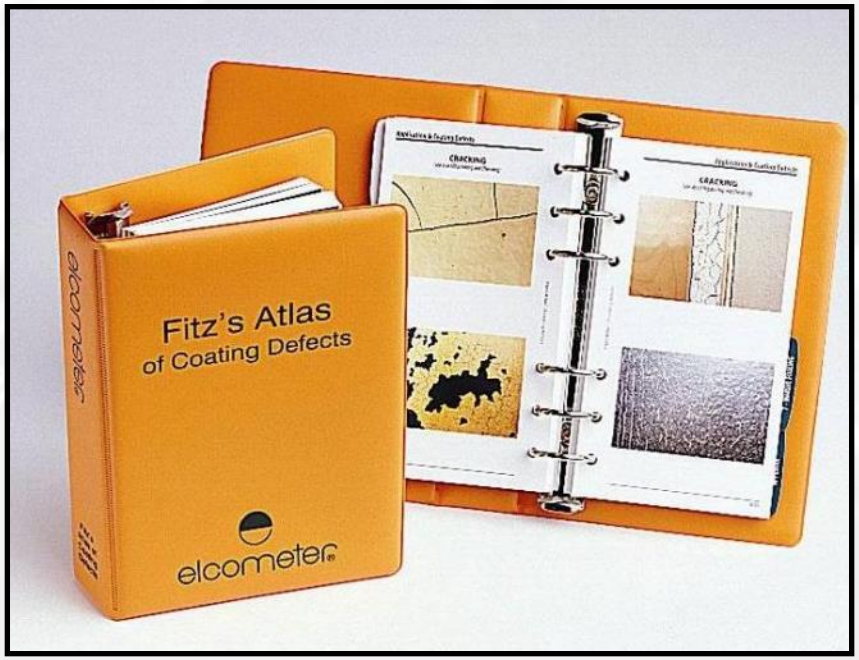
Inspector's Accessories

Publications

- Fitz's Atlas
- Macaw's Pipeline Defects

Fitz's Atlas

- Coating Defects with probable cause
- Prevention & repair suggestions



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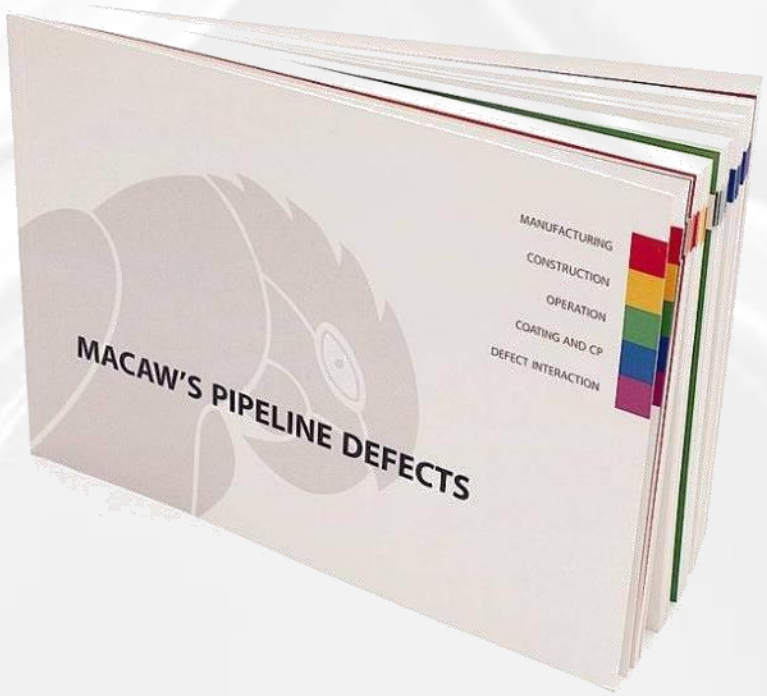
Macaw's Pipeline Defects

- 200 pages
- Colour illustrations
  - Manufacturing
  - Construction
  - Operation
  - Coating & CP
  - Defect Interaction



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Elcometer 131 Inspection Tools

- Mirrors
- Magnifier
  - x 8 Magnification

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Inspection Tools

- Safety Torch (132)

- Illuminated Magnifier (137)
  - x 10 Magnification

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Elcometer 900 Concrete Crack Microscope

- 50 x Magnification
- Integral light source
- Crack width 0.2 to 1.5 mm
- Also used for Elcometer 141

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Inspection Kits

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inspection equipment

Inspector's Kits

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Certification

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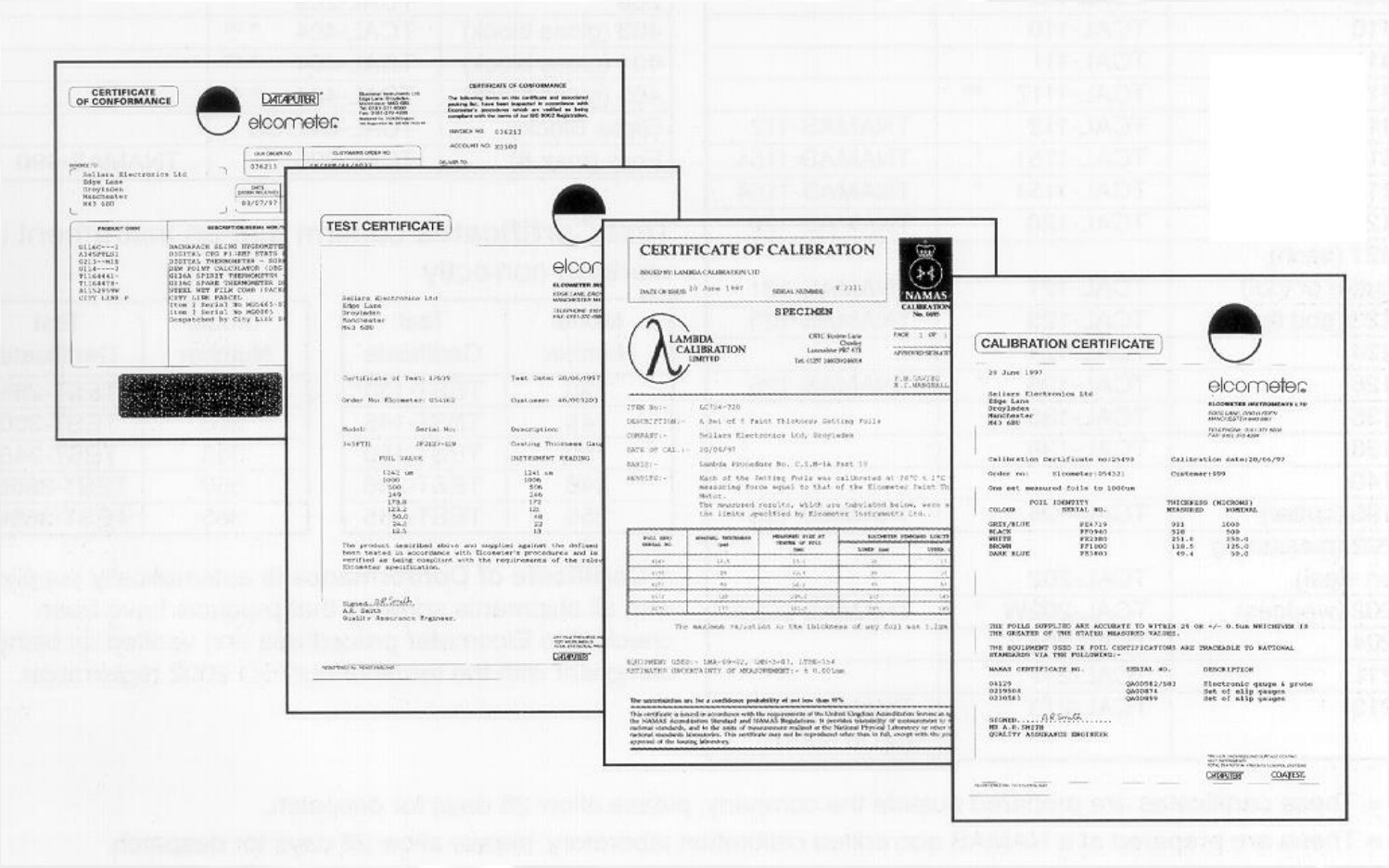

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Types of Certificate

- Certificate of Conformance
  - Goods are as described on the order
- Test Certificate
  - Results of testing to Elcometer procedures
- Calibration Certificate
  - Standards and Fixed Calibration Gauges only
- UKAS Certificate of Calibration
  - Independent Laboratory

Besides Coating Thickness, Certification can also apply to:

- Gloss
- Force (Adhesion)
- Temperature
- Dimensions
- Colour
- Viscosity (Oils)
- Voltage (Porosity)
- Humidity
- Weight
- Time