CCI Inspection Services, Inc.

Coating Inspection Instrumentation

Past, Present & Future

www.cciinspection.com

Coating Failures

Your Worst Nightmare

Three Major Causes of Premature Coating Failure

- Improper surface preparation/coating application
- Mis-selection of the coating system
- Mis-formulation of the coating

POTENTIAL CAUSES OF COATINGS FAILURES

- Poor applicator training
- Poor quality control
- Lack of qualifications by sub-contractor
- Lack of facilities to adjust environment
- Unsafe conditions
- Non-user friendly coatings system
- Prime in shop - Finish in field
- Specification non-compliance
- Improper surface preparation

COATINGS FAILURES (CONT.)

- Recoat too quickly
- Recoat to Slowly
- Lack of catalyst
- Wrong catalyst
- Improper mixing
- Lack of induction
- Improper storage
- Out of potlife
- Improper design
- Not enough millage
- Surface contamination
- Last in cycle
- Excessive profile
- Improper media
- Poor equipment maintenance
- Wrong thinners
- Improper additives
- Water in lines
- Oil in lines
- Out of shelf life
- Excessive millage
- Personnel turnover
- Concealed areas

COATINGS FAILURES (CONT.)

- Lack of time
- Poor paint quality
- Limited people
- Hoses too long
- Low air pressure
- Keep on trucking
- Language barrier
- Wrong product for service
- Lack of disclosure
- Resistance to change
- Too long between surface preparation and prime

Quality Assurance Inspection Check Points

- Substrate inspection
- Protective covering
- Ambient conditions
- Compressed air cleanliness
- Surface profile
- Surface cleanliness
- Mixing and thinning procedures
- Application procedures
- Coating thickness
- Intercoat cleanliness
- Recoat times
- Holiday testing
- Adhesion
- Gloss

QUALITY ASSURANCE INSPECTION

Quality Assurance Inspections

- Substrate inspection
  - Weld spatter removal
  - Edge preparation
  - Weld Preparation
  - Removal of grease/oil
  - Conducted prior to surface preparation

PIT DEPTH GAUGES

Fluorescenator UV Flashlight

NACE WELDING COMPARATOR

Quality Assurance Inspections

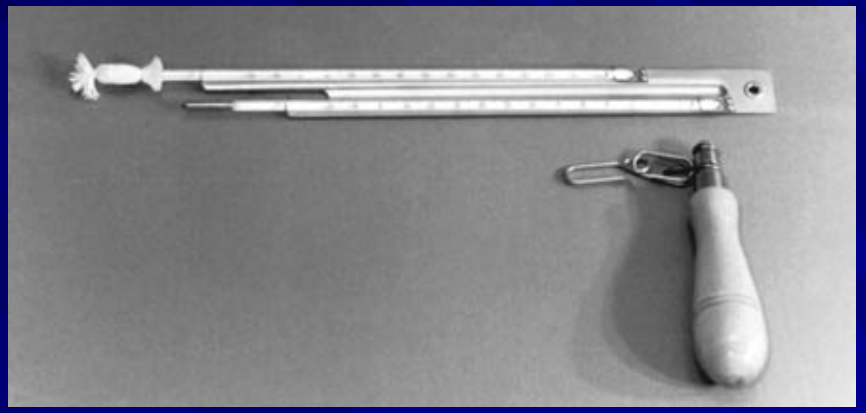
- Ambient conditions
  - Critical QA function

Dew Point/Surface Temperature Relationship

- Surface temperature (of the surface being painted) must be warmer than dew point temperature (where the painting is being done)
- Industry guideline: Surface temperature at least 5°F (3°C) above dew point temperature

Sling Psychrometers

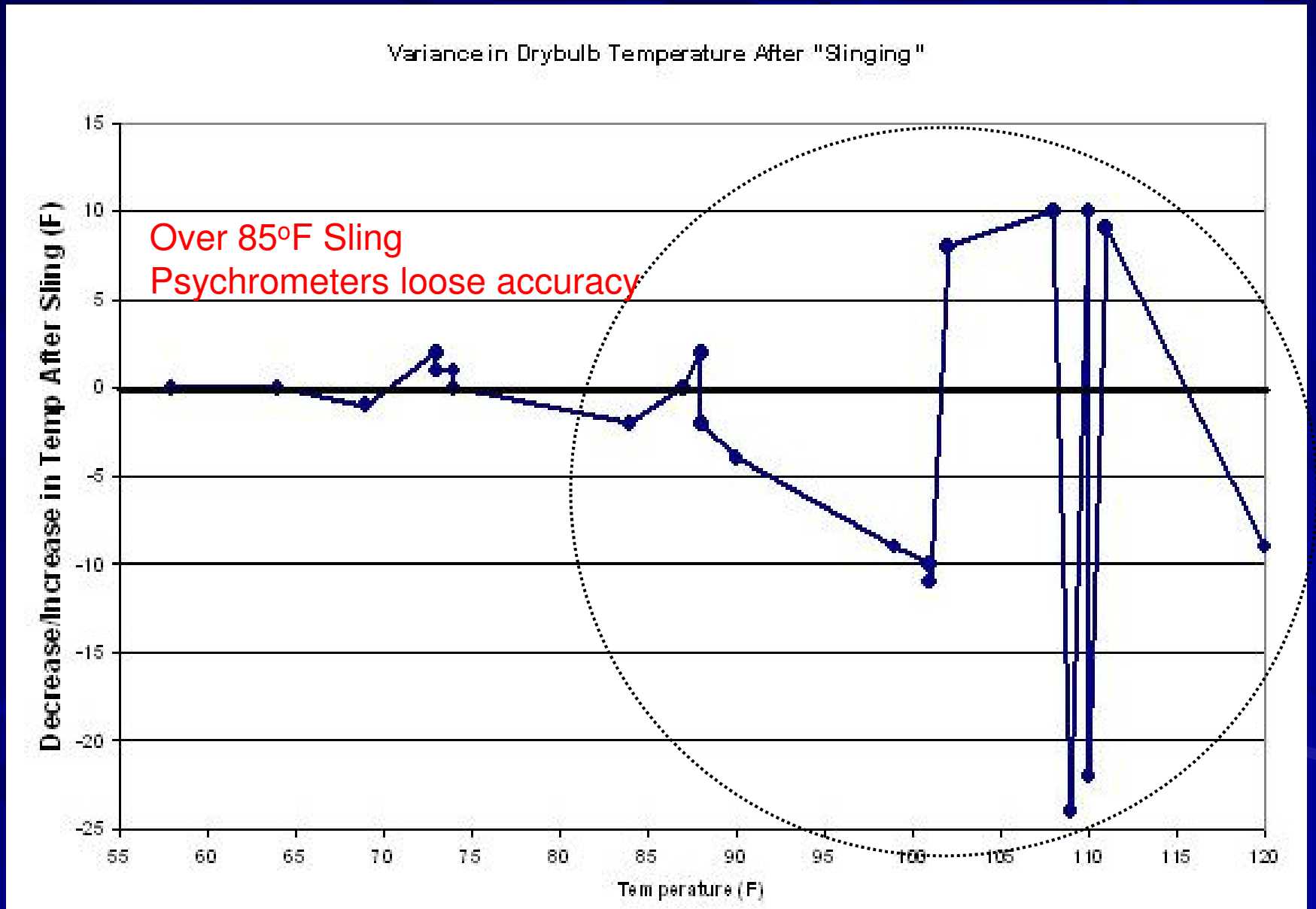
Typical Sling Used by most Coatings Professionals



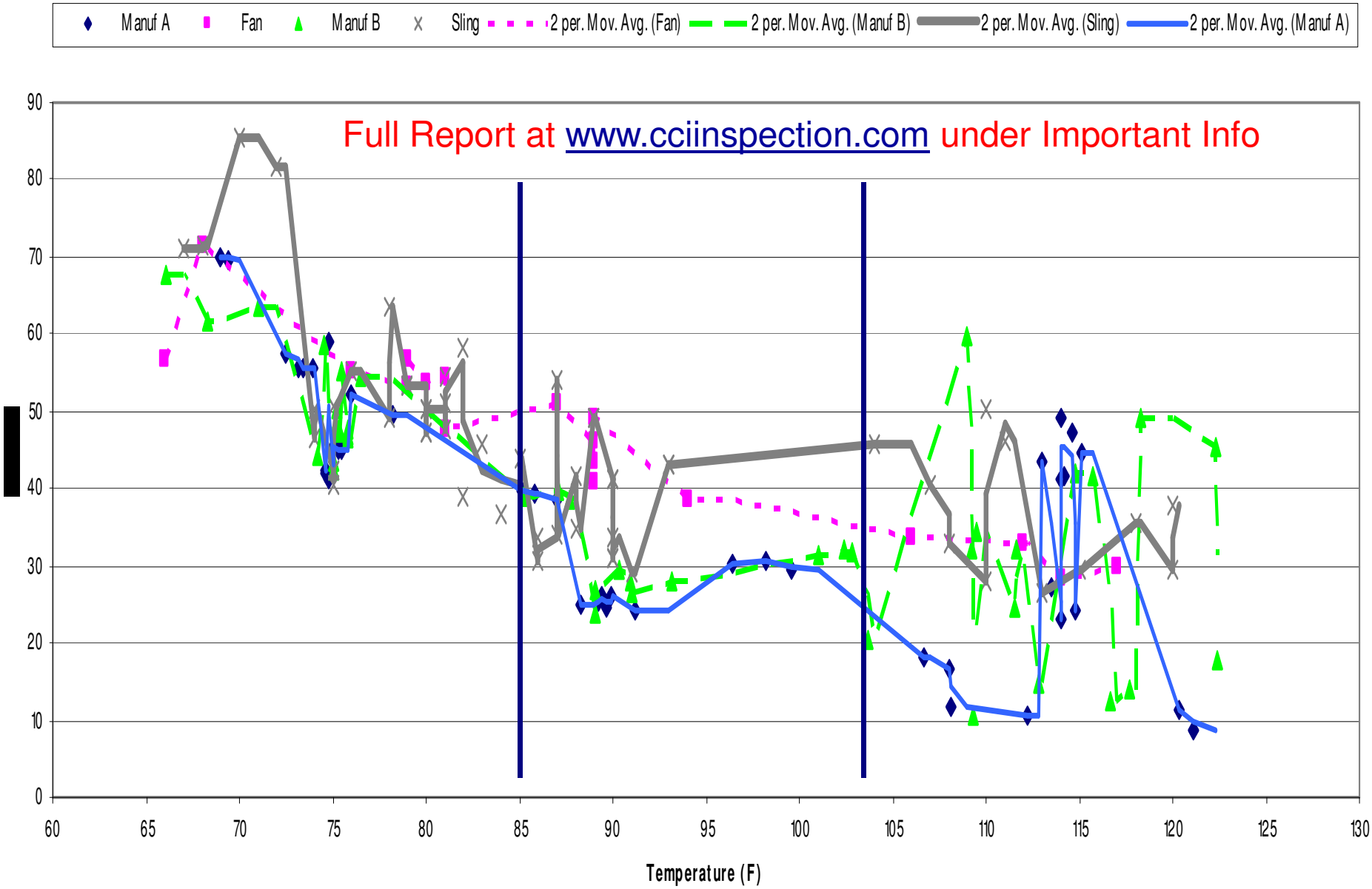
Sling that meets the requirements of the National Weather Service

ASTM E337-02 Precision and Bias (Table 2)

Uncertainty in Derived Relative Humidity, %RH	Uncertainty in Temperature Depression, °C (°F)	Uncertainty in Dry-Bulb Temperature, °C (°F)
±4	±0.3 (±0.54)	±0.2 ±(0.36)
±3	±0.2 (±0.36)	±0.2 ±(0.36)
±5	±0.3 (±0.54)	±0.6 ±(1.08)
±4	±0.2 (±0.36)	±0.6 ±(1.08)


Variance in Drybulb Temperature After "Slinging"
Over 85°F Sling
Psychrometers loose accuracy
Decrease/Increase in Temp After Sling (F)
15
10
5
0
-5
-10
-15
-20
-25
55
60
65
70
75
80
85
90
95
100
105
110
115
120
Temperature (F)

Temperature vs. RH - Combined Data



Electronic Meters

•Air Temperature - Relative Humidity - Surface Temperature - Dewpoint

•Delta T - the difference between dew point and surface temperature.

•Alarm - Indicating when the climatic conditions are "unsafe" to paint.

•Memory - Store up to 99 datasets* in the internal memory.

•Date & Time - Each dataset is stored with date and time stamps.

•Dataset Reading Review - See all the readings stored in the memory

•IR Output - Direct infrared output to your HP IR Printer

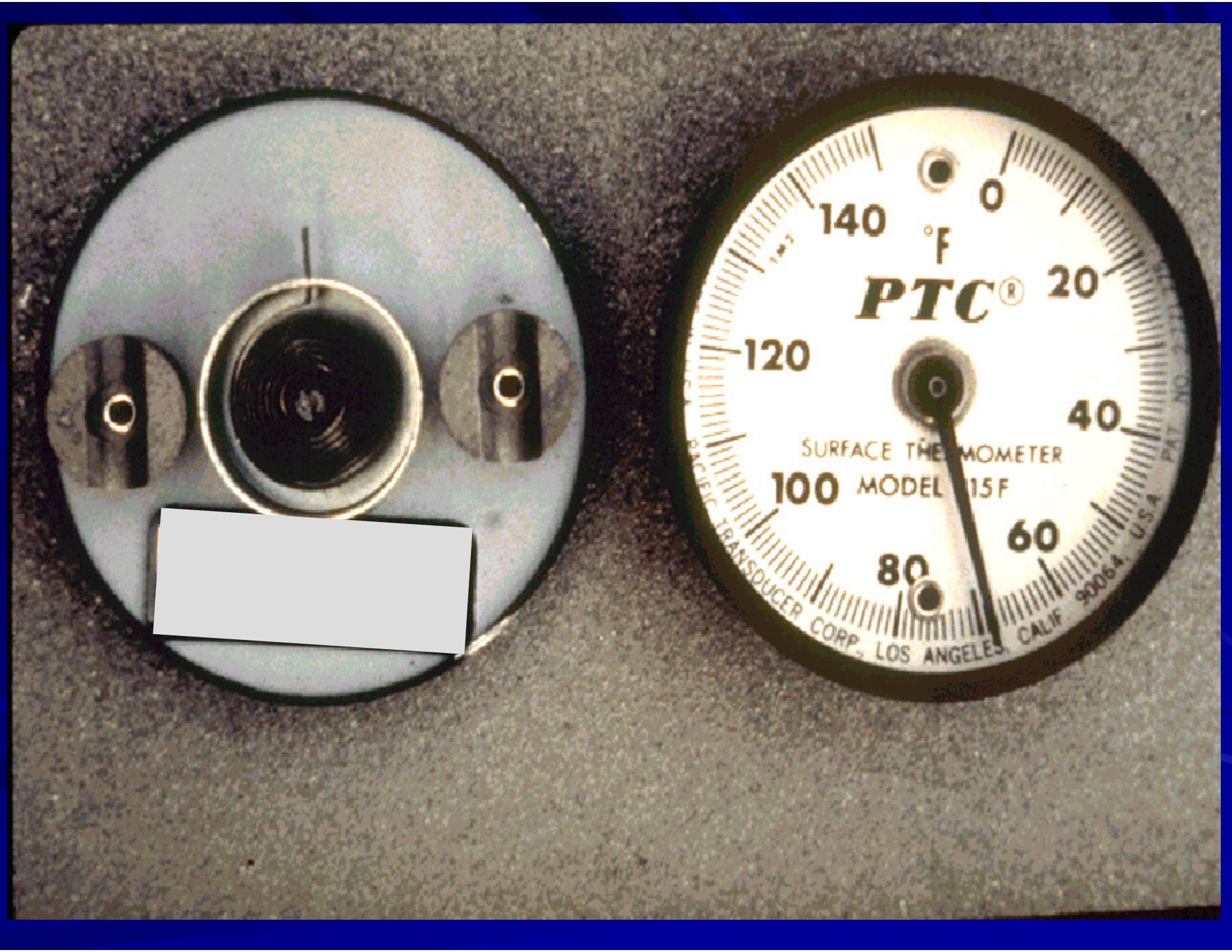
Digital Psychrometer + InfraRed Thermometer

Features:

Triple display with backlighting
InfraRed Thermometer with
Built-in laser pointer
8:1 distance to target ratio
Adjustable Emissivity from 0.3 to 1.0
-40 to 932F
Precision humidity capacitance sensor is retractable for protection during transportation and storage
Calculates T1 (IR Surface Temperature) - DP (Dew Point) differentia

ACCURACY AND LINEARITY OF SLING AND DIGITAL PSYCHROMETERS

- Determining the accuracy of each of the test instruments was beyond the scope of this study. We do believe it is safe to say, based on the data that caution should be used when using a sling psychrometer. ASTM E 337 precision and bias numbers and testing by the US Military show that using a sling psychrometer that meets the standards of the method would yield at best ±5% to ±9% error in Relative Humidity and with the typical thermometers used in the coating industry, that error would easily exceed this amount. Relative Humidity taken using a sling psychrometer appears to be much greater than electronic sensors in the 85ºF range and greater.


0
20
40
60
80
100
120
140
°F
PTC®
SURFACE THERMOMETER
MODEL 15F
PACIFIC TRANSDUCER CORP. LOS ANGELES, CALIF. 90064 U.S.A.

Surface Temperature Thermometers

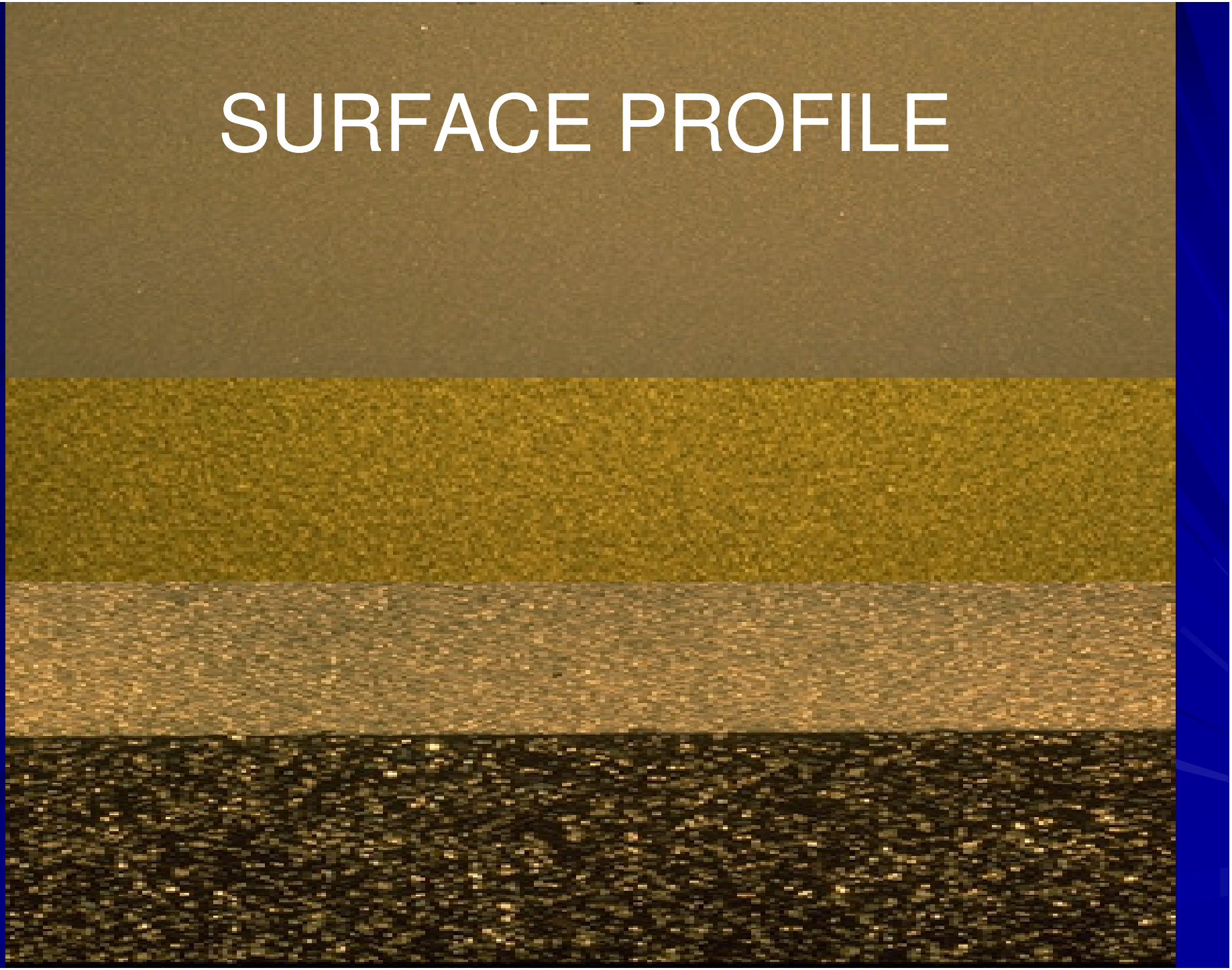
SURFACE PREPARATION

The Key to a Successful
Coatings Application

Surface Preparation

- Surface profile (roughness)
- Surface cleanliness
  - Most difficult inspection
  - Visible and invisible contamination

SURFACE PROFILE



Quality Assurance Inspection

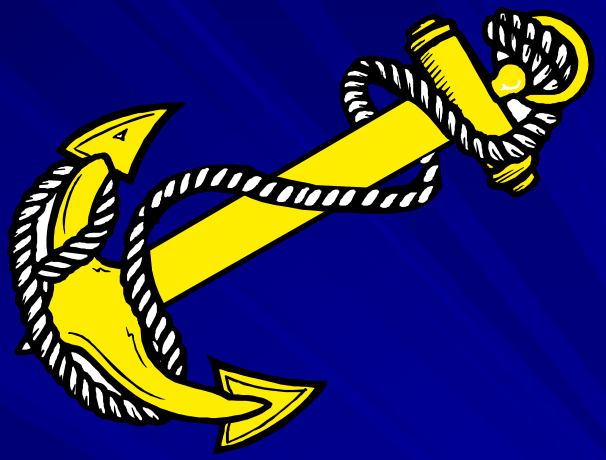
- **ASTM D4285-83(2006) Standard Test Method for Indicating Oil or Water in Compressed Air**
- Compressed air cleanliness
  - Blast cleaning air
  - Blow down air
  - Conventional spray atomization air

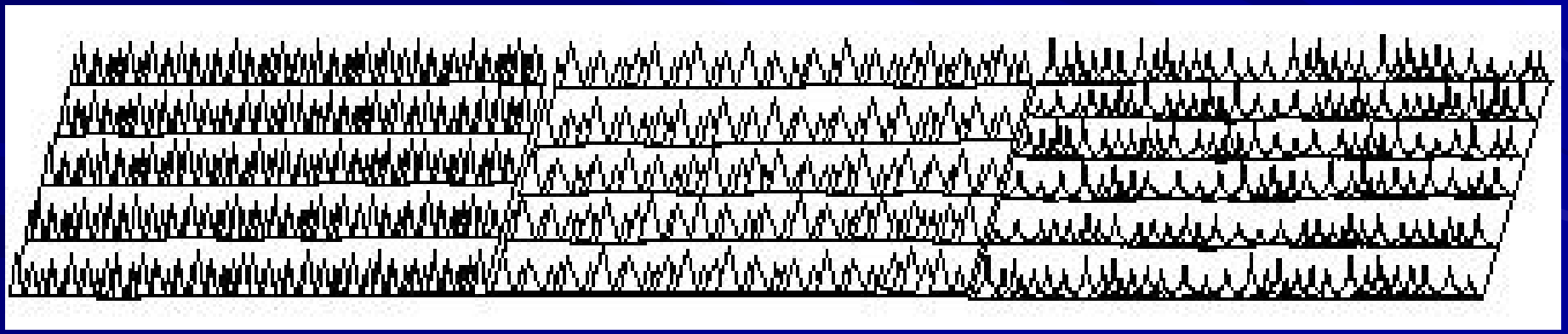
Anchor Pattern or Profile

SHOT: compacted and peened surface.

GRIT: sharp, angular cut surface.

SAND: finely cut, scoured surface.





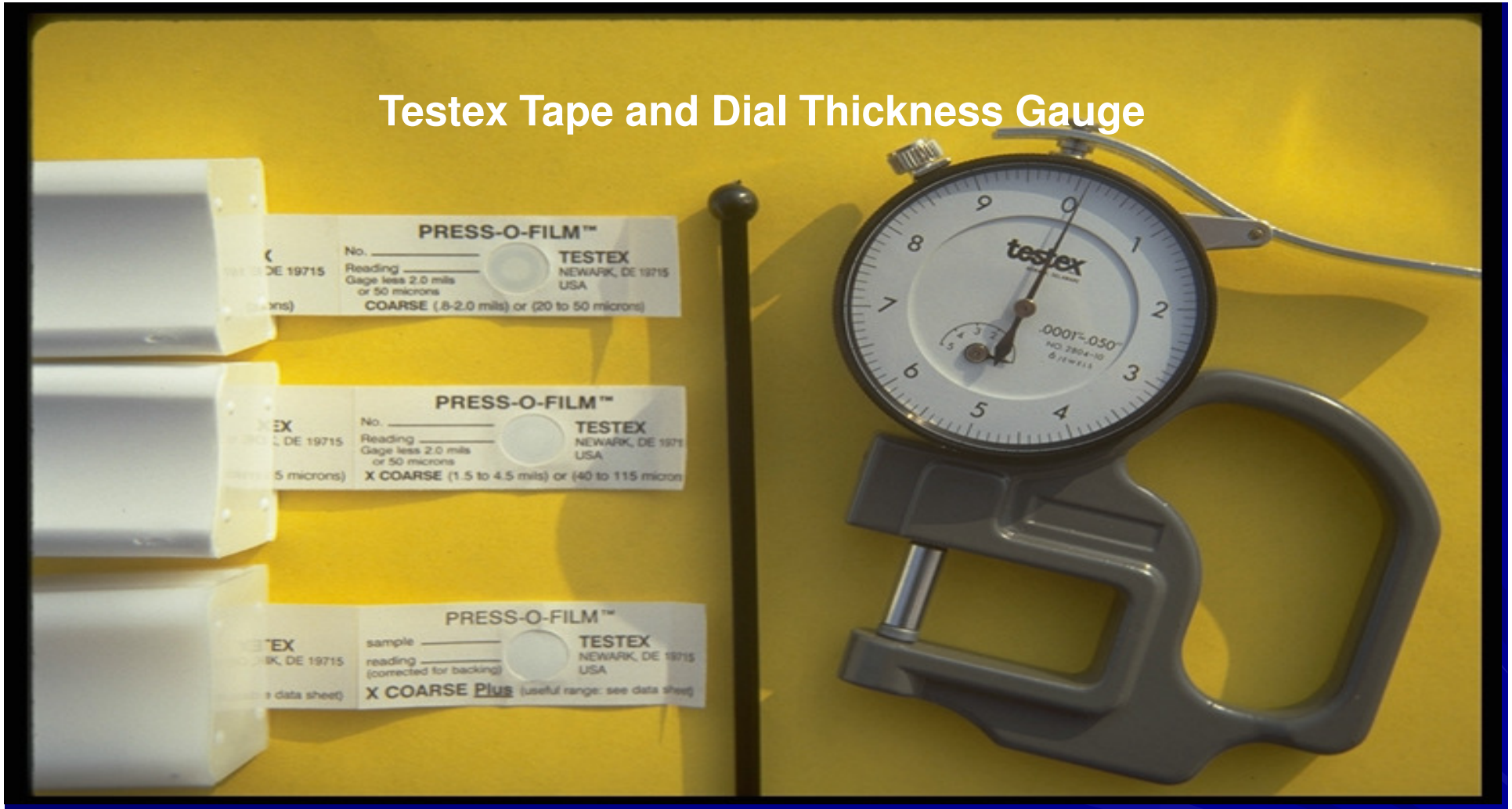
Advantage: Quick to take measurements

Disadvantages: Requires calibrated eye (experienced)

Different blast media give different visual appearances

No record of test

Testex Tape and Dial Thickness Gauge



Advantage: Gives Permanent Record

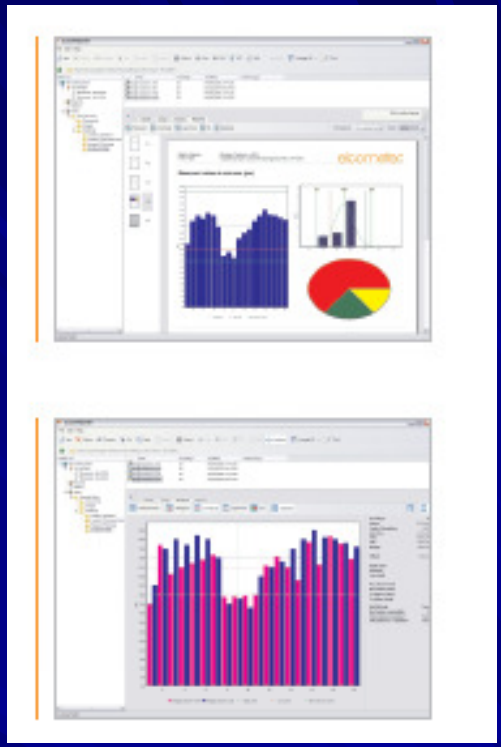
Disadvantages: $.64 per test

Gives MAXIMUM Profile

Can be used wrong

PROFILE GAUGES

Dial Profile Gauge



Digital Surface Profile Gauge (NEW TECHNOLOGY)

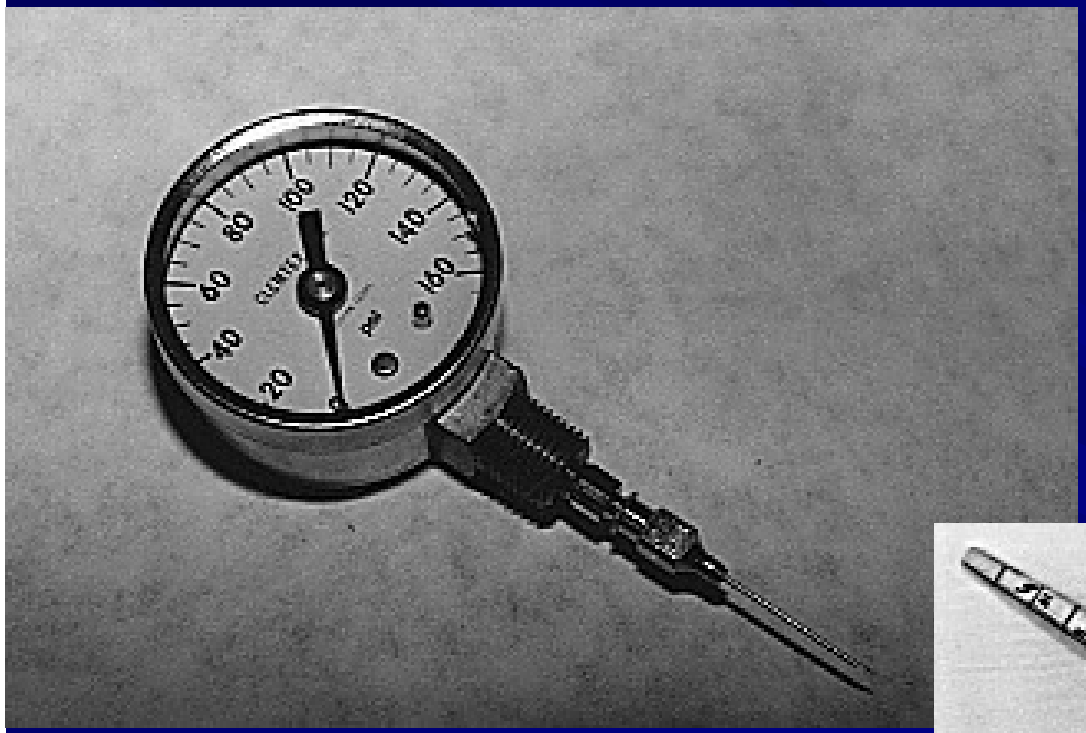
Similar to the Elcometer 123, this gauge provides a digital answer and the **Bluetooth** and RS232 (USB) port allows data to be transferred to a computer.

Advantage:	Quick to take measurements
	Gives True Average
	Electronic Version Gives Record
Disadvantages:	High One Time Cost

Blasting Efficiency

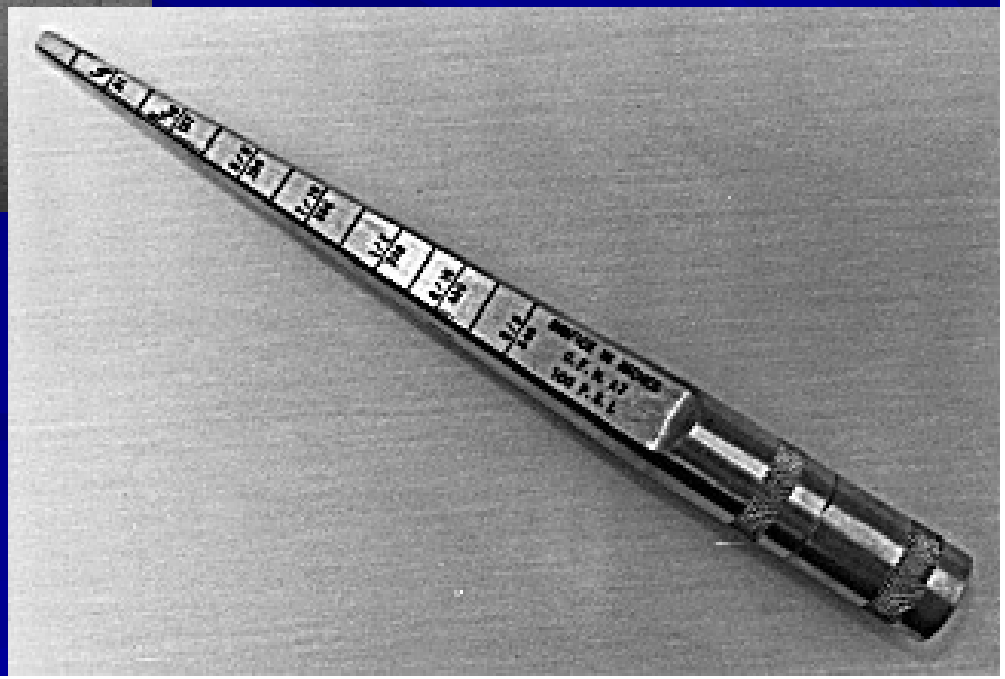
- A 1/16 increase in nozzle orifice size can increase the volume of air required by 25% to maintain the same pressure.
- Blast hose diameter should be 3 to 4 times the diameter of the nozzle being used.
- Each 1 psi drop in air pressure gives about a 1.5% decrease in efficiency. Eg. A 10% drop in psi = 15% loss of efficiency.

ABRASIVE BLASTING EFFICENCY



Pressure Needle Gage

Nozzle Orifice Gage



Visible Surface Cleanliness

- SSPC-SP1 - Solvent Cleaning

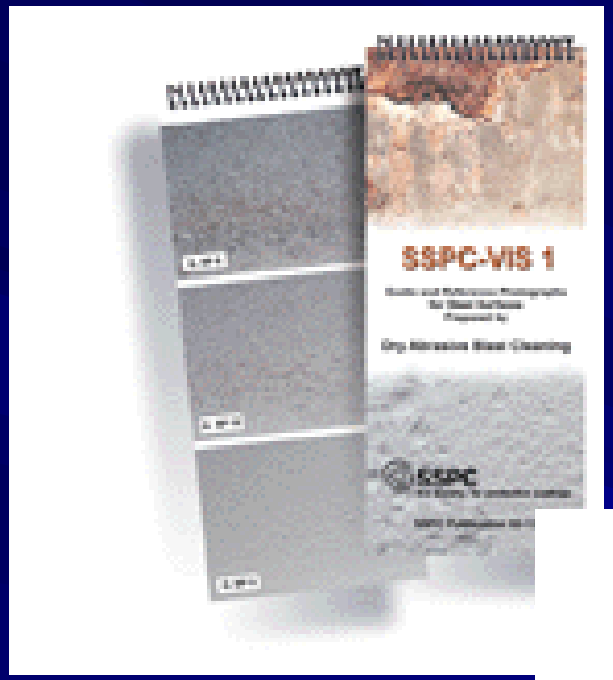
- SSPC-SP2 - Hand Tool Cleaning
- SSPC-SP3 - Power Tool Cleaning
- SSPC-SP11 - Power Tool Cleaning to Bare Metal
- SSPC-SP 15 - Commercial Grade Power Tool Cleaning

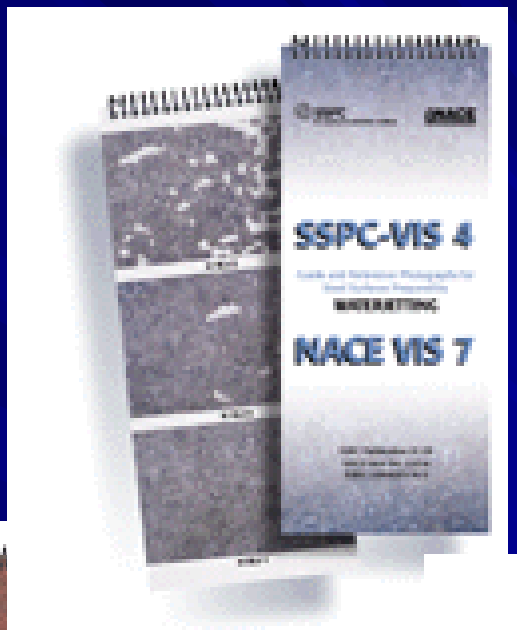
- NACE No. 4/SSPC-SP7 - Brush-Off Blast Cleaning
- NACE No. 3/SSPC-SP6 - Commercial Blast Cleaning
- NACE No. 2/SSPC-SP10 - Near-White Metal Blast Cleaning
- NACE No. 1/SSPC-SP5 - White Metal Blast Cleaning
- NACE No. 8/SSPC-SP14 - Industrial Blast Cleaning

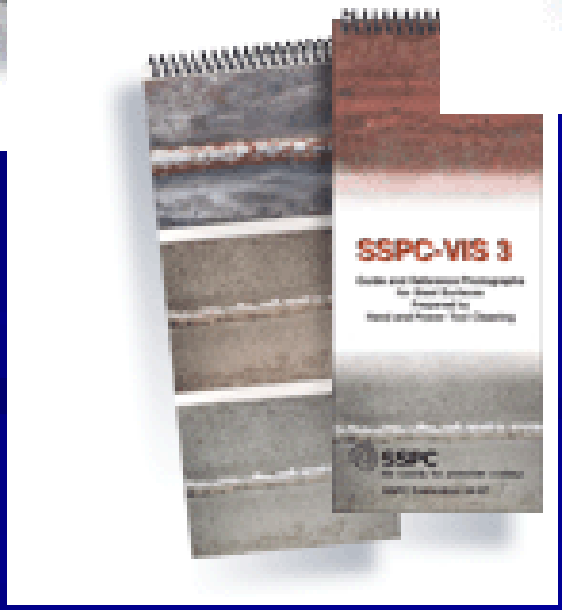
- NACE No. 5/SSPC-SP12 - High/Ultra Pressure Water Jetting

- NACE No. 6/SSPC-SP13 - Preparation of Concrete

SSPC VIS STANDARDS







INVISIBLE CONTAMINATS

- Chloride Tests
  - Ion Specific Test
- Salt Tests
  - Conductivity

Salt Detection Kit for Blast Cleaned Surfaces

Chloride Salts left on the surface before the first coat is applied can result in the coating system being forced off the surface by corrosion product - before the full life of the coating has been achieved.

To ensure that the chloride has been removed it is essential that the surface is tested before the coating is applied.

Chloride Ion testing can now be achieved quickly and accurately using a novel extraction method, based on the CHLOR*EXTRACT™ solution.

- **No needles are involved**
- **This test does not contain mercury**

Salt Contamination Meter

Soluble salts on a surface are absorbed into a special filter paper soaked with distilled water. The meter measures the conductivity of the wet paper, calculates the salt level and displays it in ug cm^{-2} .
Suitable for a wide range of shapes, orientations and surfaces and finishes
Quick and simple to use
Battery operated and portable
Test papers can be re-moistened and a similar test result can be achieved - ideal for proof and ISO requirements
Accurate
Repeatable
Reproducible

INVISIBLE CONTAMINANTS

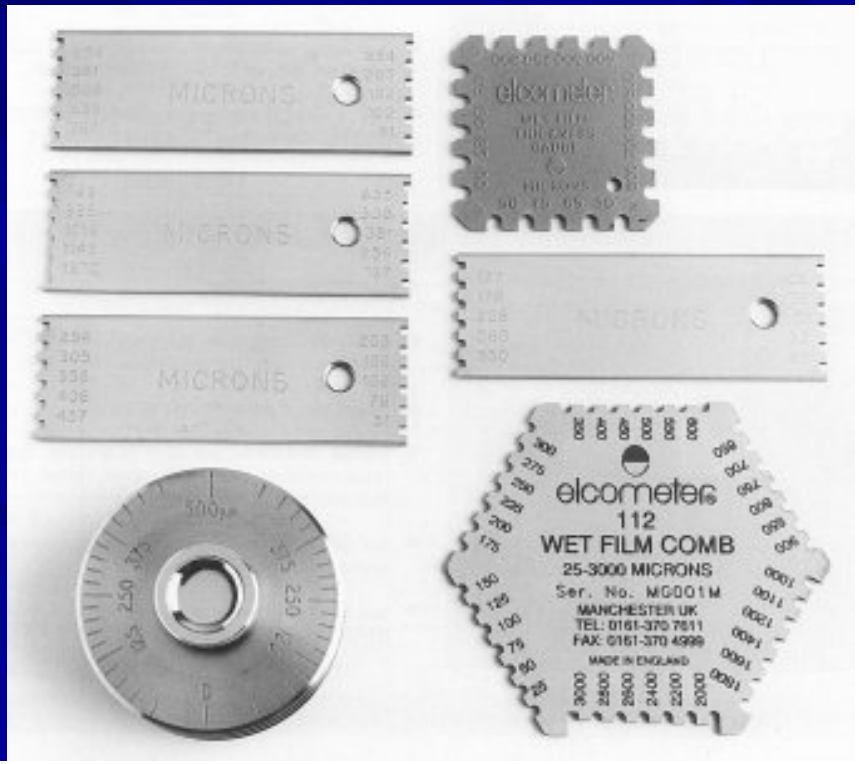
- No test measures all the salts or chlorides on the surface
- Flash Rusting is a sign Salts/Chlorides may still be present
- There is no “Magic Number”. Follow the specs or coating manufacturers recommendation
- Most Specs are overly conservative

APPLICATION INSPECTION

Inspection of Coating Application Procedures

- Application technique
- Wet film thickness measurements

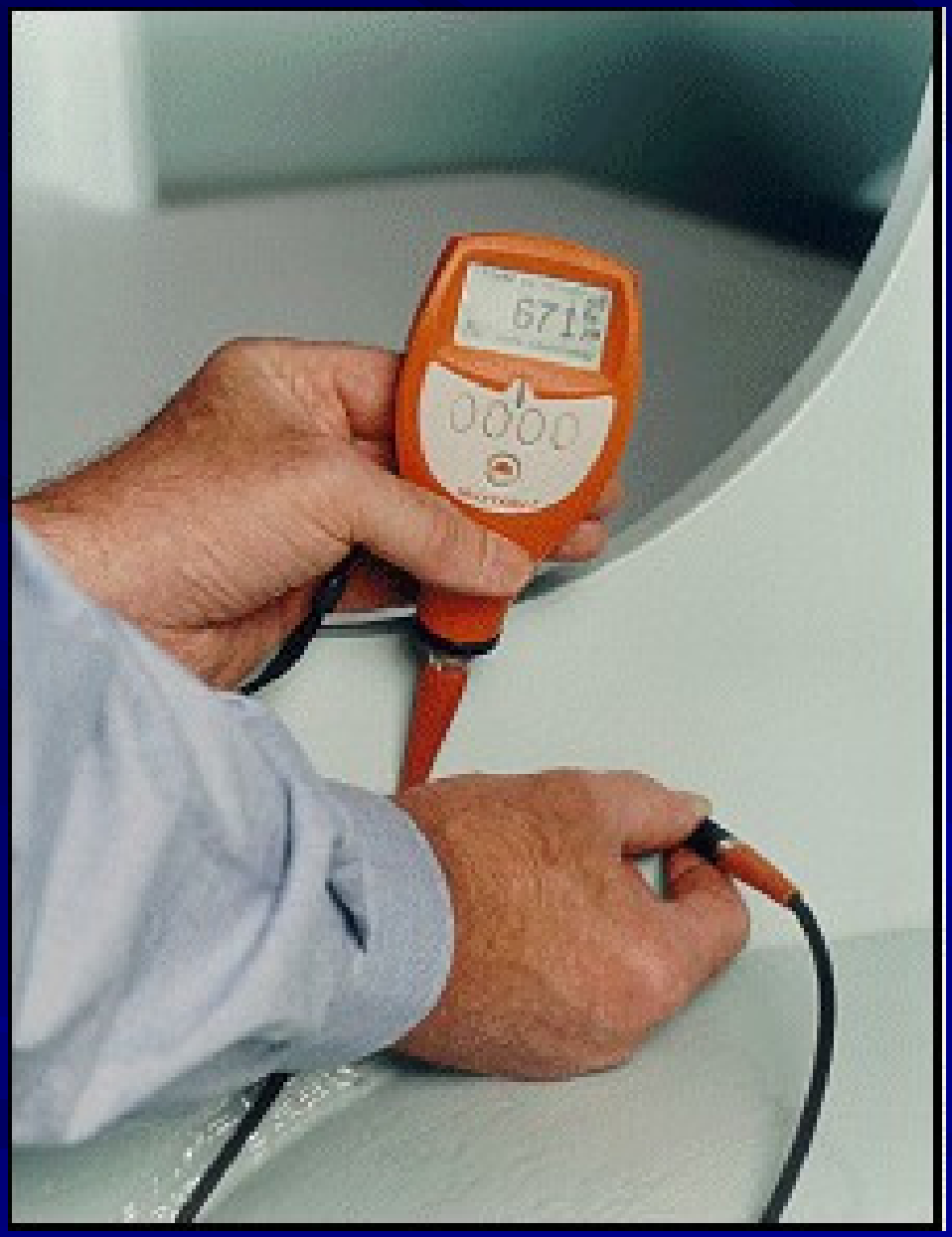
Hexagonal Wet Film Comb



Quality Assurance Inspection

- Coating thickness
  - One of the most important inspection points

Type 1 Coating Thickness Gauge

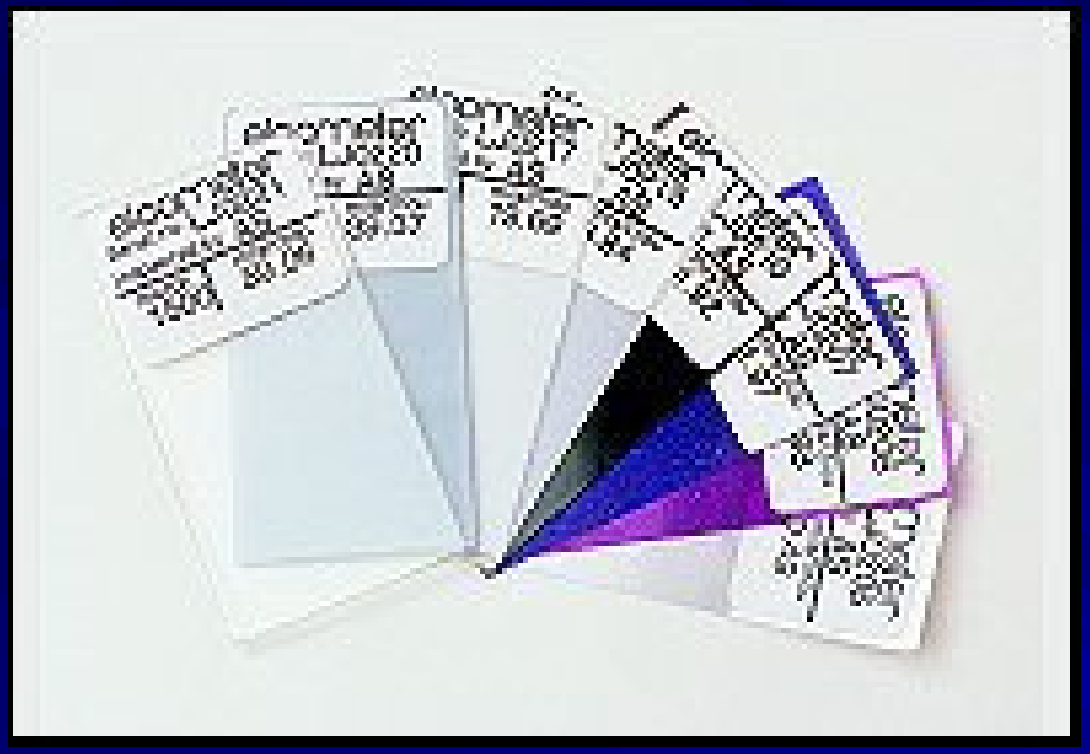


Type 2 Coating Thickness Gauge

Some of the gauge's features:

- **Full Menu Driven Display -** in the following languages -
- English, Chinese, Czech, Danish, Dutch, Farsi, French, German, Greek, Hebrew, Italian, Japanese, Korean, Portuguese, Russian, Slovenian, Spanish, Swedish, Norwegian, Polish, Malaysian and Indonesian
- **High Speed Accurate Readings -** greater than 60 per minute
- **Three Model Options** - Basic, Standard, ,Top
- Bluetooth Enabled
- Interchangeable Probes - Including **NEW PLUG IN INTEGRAL PROBES**
- **Standard and Predefined calibration Options**
- **Free Analysis Software* provided**
- **Both IR and Cable* Data Output**

BLUETOOTH (NEW TECHNOLOGY)



Coating Thickness Shims

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- micron and mil values displayed
- available individually or in sets
- precision and certified foils available
- ± 1% or ±2% accuracy foils available
- each foil has a unique serial number for traceability to national standards
- available in thicknesses from 12.5microns up to 8mm (0.5 - 315mils)

P.I.G - Paint Inspection Gauge

Destructive thickness measurement is not only often the only guaranteed method available to test certain coating/substrate combinations such as paint applied to concrete, wood, plaster etc, but also the only method to identify individual layer thicknesses of a multi-layer coating system.

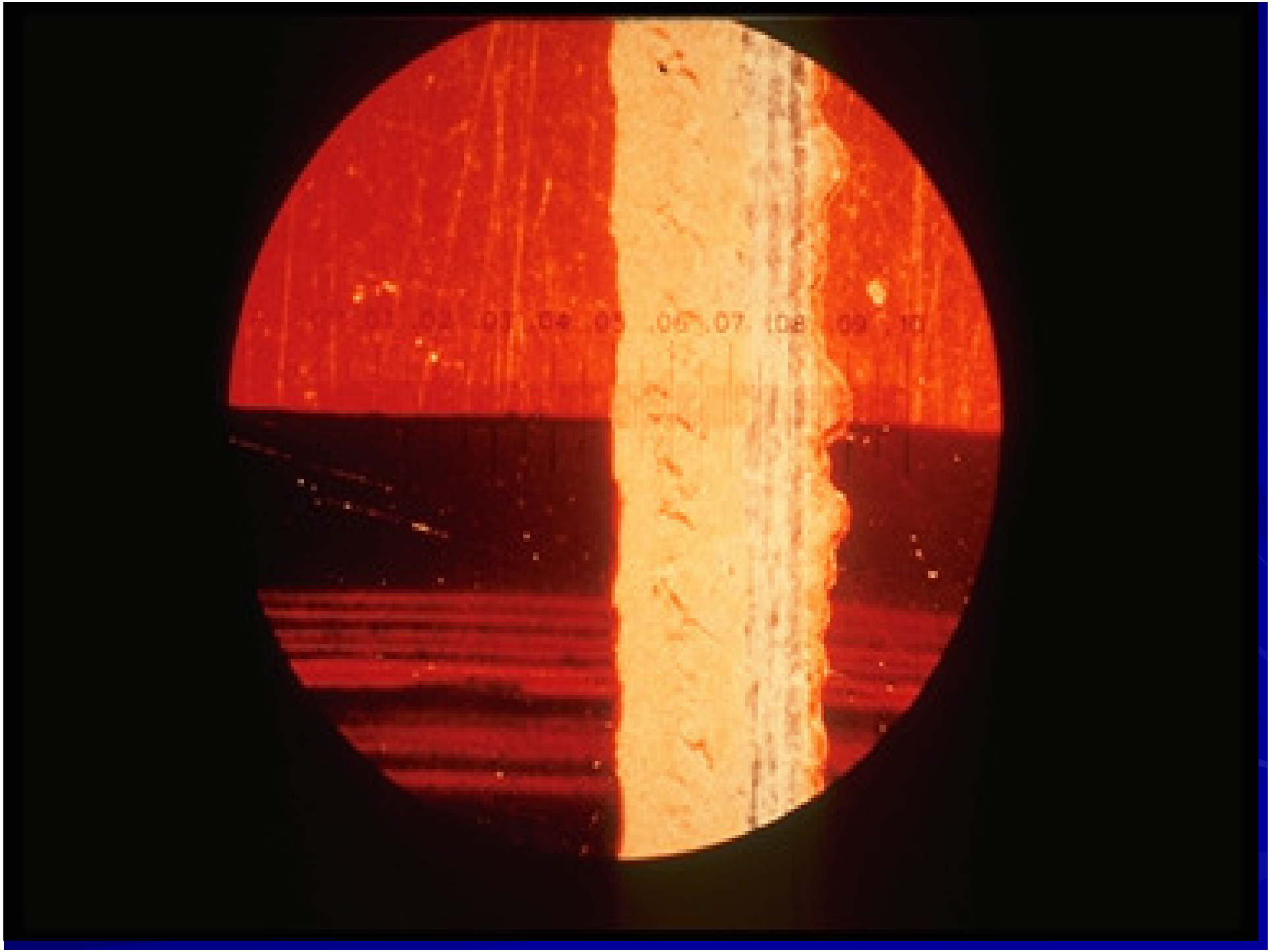
•The PIG offers a quick, versatile method of coating examination and measurement in a portable, easy to use instrument. Ergonomically designed to give a balanced weight distribution for a more consistent cut.

•Large easy to grip handle - allows the operator to cut thick or hard coatings easily

•Internal cutter storage compartment

•x50 magnification direct measurement microscope

Tooke Gauge

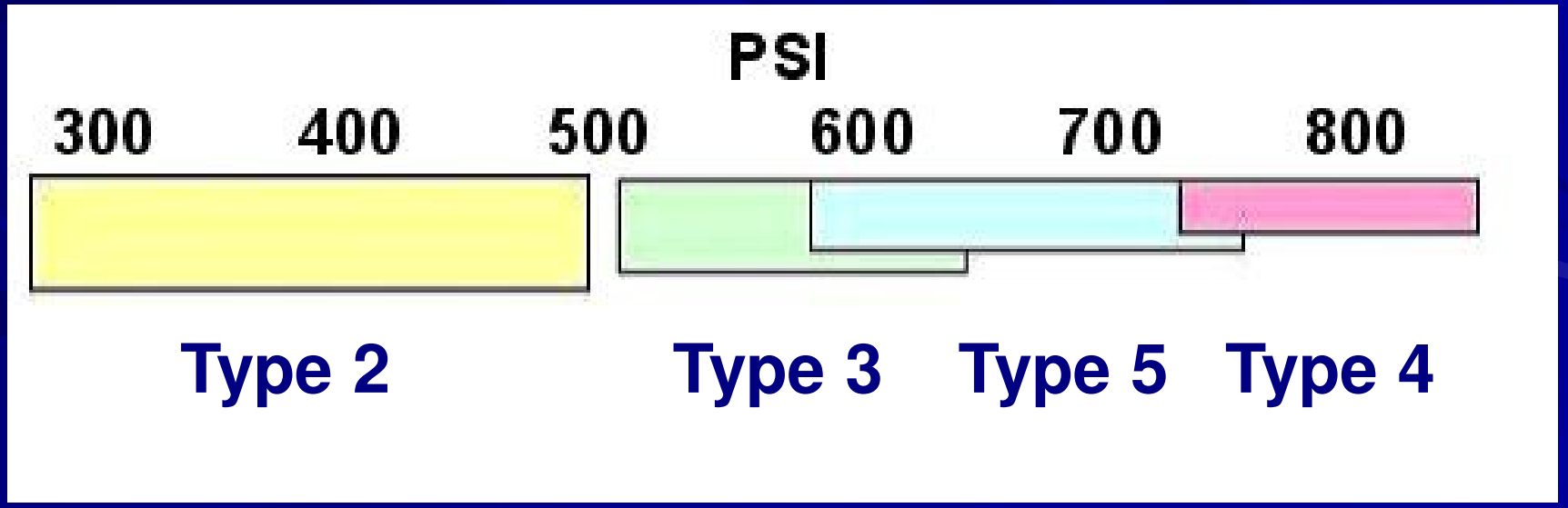


Holiday Detection

- Low Voltage – Sponge Test
  - Coatings up to 20 mils
  - ASTM – 67.5 Volts
  - ISO – 9 or 90 volts
- High Voltage – Spark Test
  - Up To 30,000 to 35,000 volts
  - Rule of Thumb – 100 volts per mil of coating

Tensile Adhesion Testing

- Mechanical (Type 2)
- Pneumatic (Type 4)
- Hydraulic (Type 3 & 5)
- Results reported in psi



Type 2 Adhesion Tester

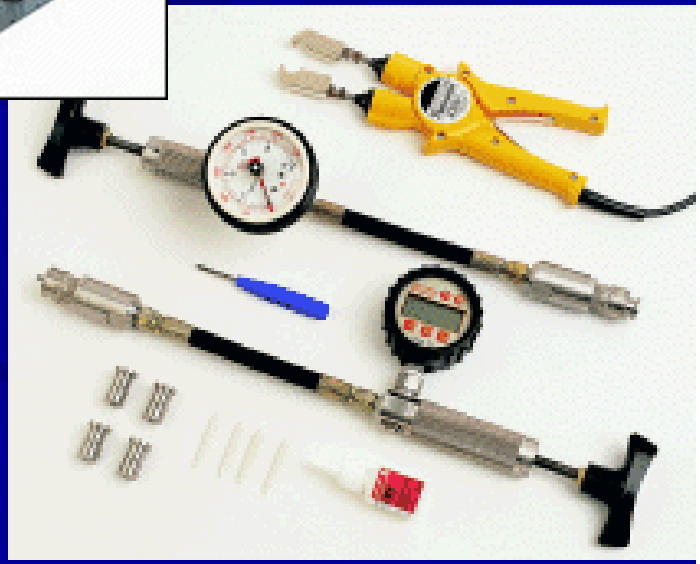
The mechanical adhesion tester - easy to operate and fully portable, provides a numerical value for adhesion. Applications include: paint or plasma spray on bridge decking, coatings on steel, aluminum or concrete, etc.

- Fully portable and comes in a carrying case
- Hand operated so you don't have to worry about a power supply!

Can be used in accordance with ASTM D4541, ISO 4624 and BS EN 24624 test methods

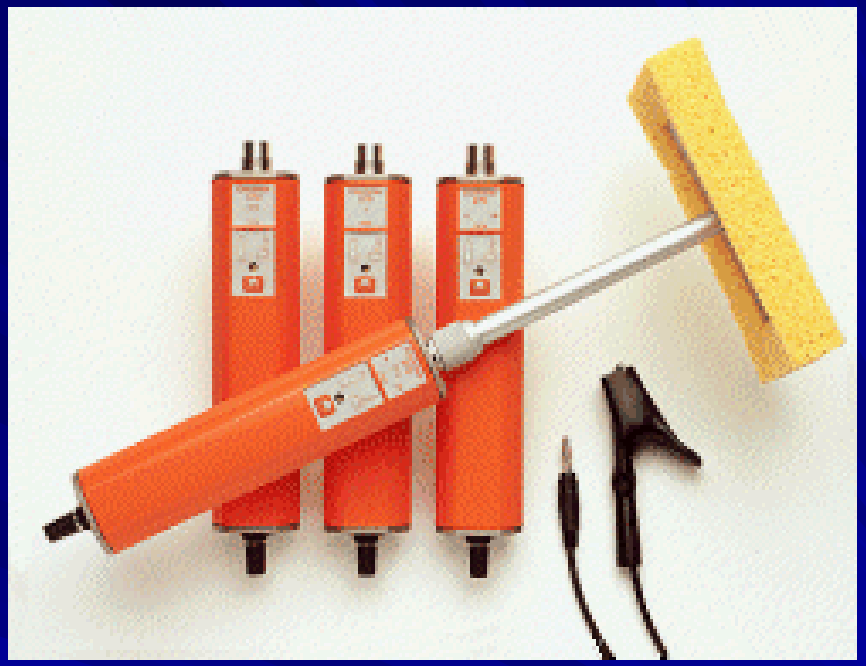
Type 4 Pneumatic Adhesion Tester

Type 5 Adhesion Tester
(NEW TECHNOLOGY)



Type 3 Hydraulic Adhesion Testers

High Voltage



Sponge Tester

UV Detection

(NEW TECHNOLOGY)

EXAMPLES OF INSPECTION EQUIPMENT

- Solvent Vapor/Oxygen Meter
- Surface Temperature Thermometer
- Sling Psychrometer & Psychometric Tables
- Electronic Dewmeter
- Wind Meter
- NACE RP0188
- Mirror
- Flashlight
- Ultraviolet Light
- 30X Magnifier
- Chloride Test Kit

INSPECTION EQUIPMENT (continued)...

- Micrometer & Replica Tape
- Needle Pressure Gauge
- Nozzle Orifice Gauge
- Cleanliness Standards (SSPC-Vis 1, VIs 2, Vis 3)
- Liquid Temperature Thermometer
- Wet Film Thickness Gauge
- Dry Film Thickness Gauge - (Type 1)
- Dry Film Thickness Gauge - (Type 2)
- Holiday Detector - Low Voltage Wet Sponge
- Holiday Detector - DC Type High Voltage

INSPECTION EQUIPMENT (continued)...

- Liquid Temperature Thermometer
- Wet Film Thickness Gauge
- Dry Film Thickness Gauge - Magnetic Pull-Off (Type 1)
- Dry Film Thickness Gauge - Fixed Probe (Type 2)
- Holiday Detector - Low Voltage Wet Sponge
- Holiday Detector - DC Type High Voltage

INSPECTION EQUIPMENT (continued)...

- Tooke Gauge
- Adhesion Testing Equipment - X-Cut - Knife & Permacell Tape (ASTM D-3359)
- Adhesion Testing Equipment - Elcometer 106 (ASTM D-4145)
- Barcol Impressor
- Solvent Sensitivity

REFERENCE MATERIALS

- “Corrosion Prevention by Protective Coatings” by Charles G. Munger
- “Good Painting Practice - Steel Structures Painting Manual Volume 1” by SSPC
- “Systems and Specifications - Steel Structures Painting Manual Volume 2” by SSPC

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