Changing the perspective of surface preparation methods through innovation

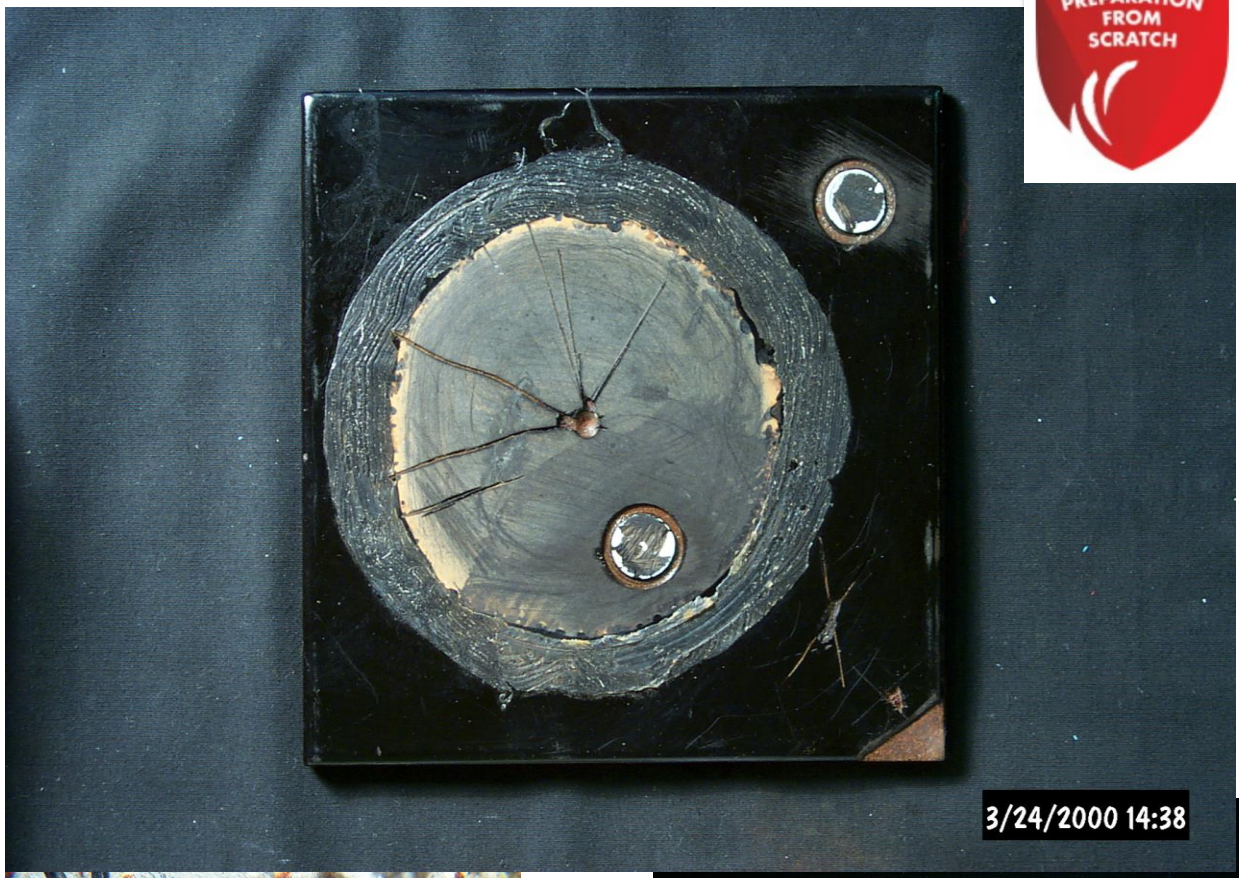
DINKO CUDIC

SENIOR TECHNICAL ADVISOR

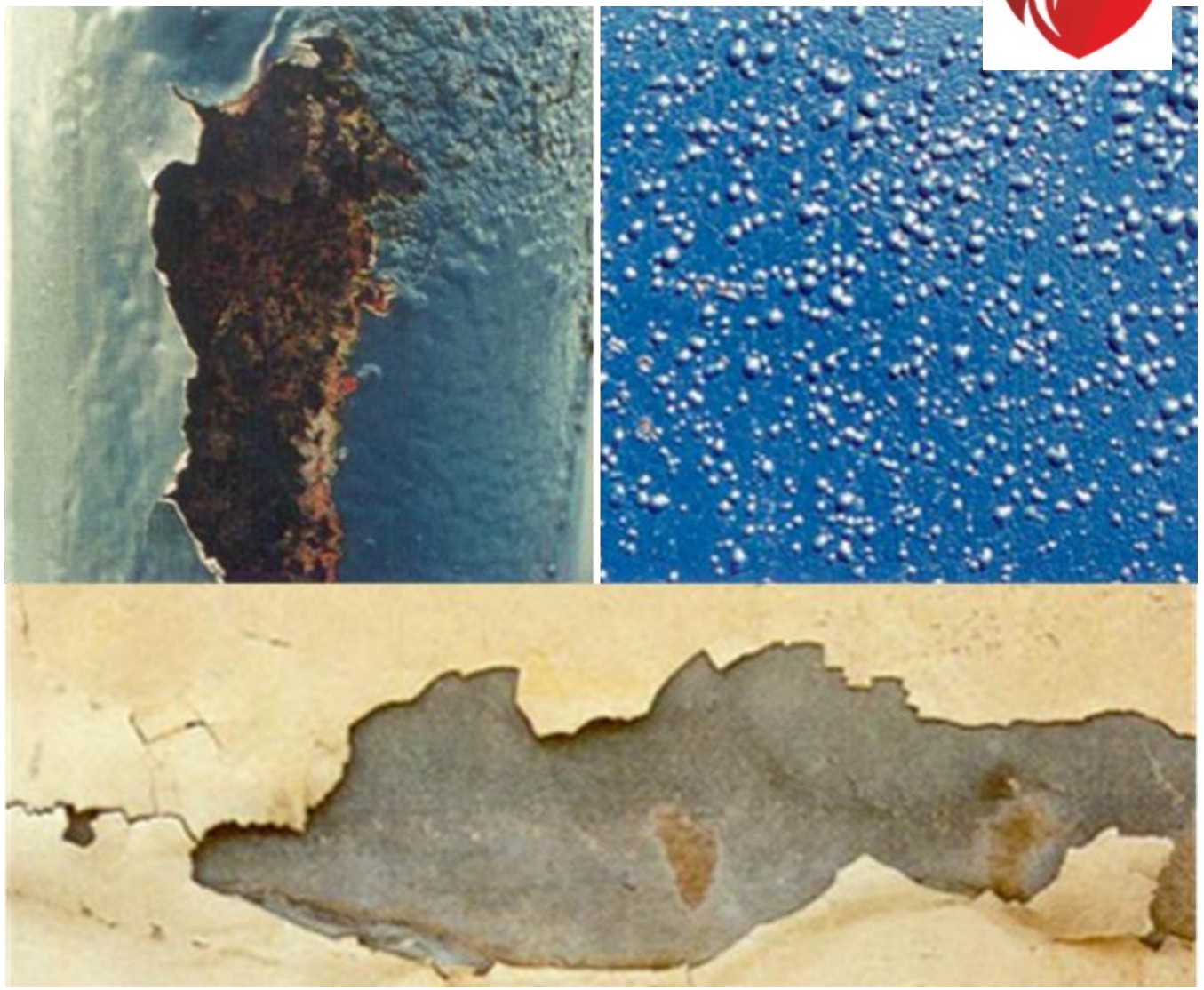
MONTI

IPLOCA Novel Construction Fall Session, Geneva, 23 - 24 October 2019

Laboratory testing

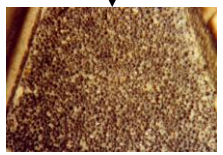
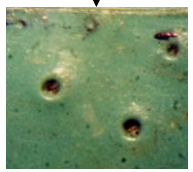
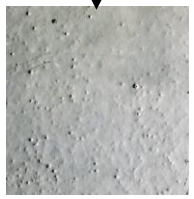
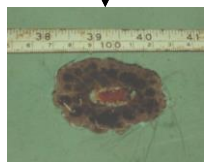


Field experience



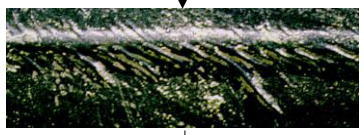
PREPARATION FROM SCRATCH

PLANT APPLICATION

- Through thickness properties
  - Foaming
    
  - Inclusions
    
  - Roughness / Pinholes
    
- Adhesion to the metal substrate
  - Poor Adhesion
    - FBE
      
    - Three Layer PE
      
    - Liquid Systems
      
  - Leopard spots
    - Cathodic Disbonding
      
  - Blisters
    

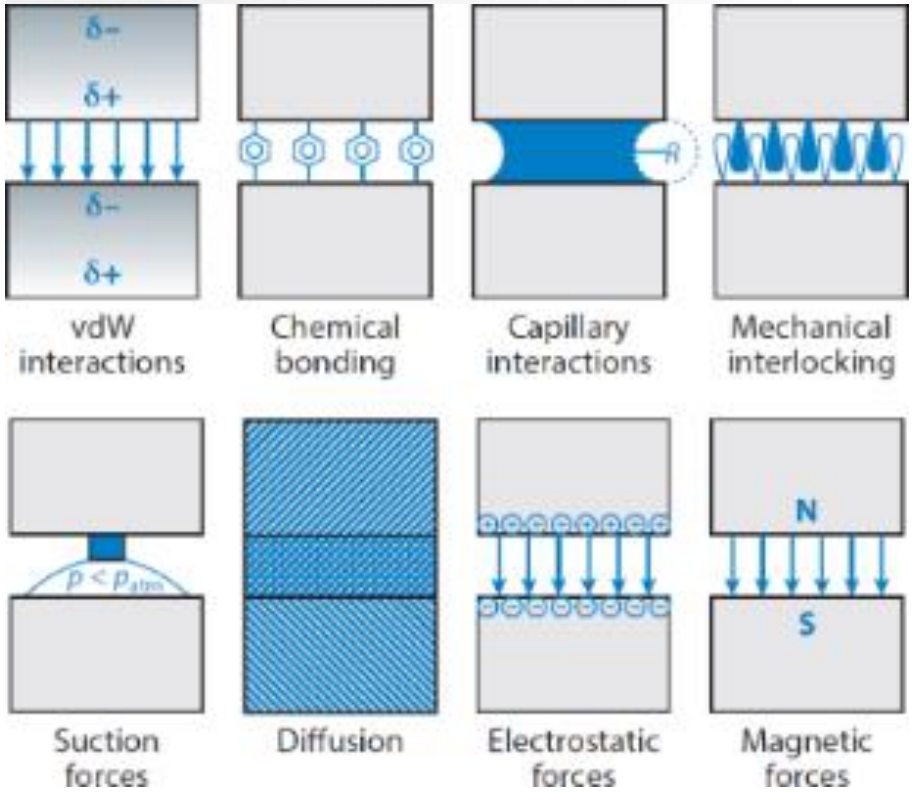
PREPARATION FROM SCRATCH

SITE APPLICATION

- Cold Applied Tape
  - Insufficient Overlap
    - 
    - 
  - Tenting / Bridging Seam Weld
    - 
    - 
- Heat Shrink
  - No adhesion at 6 o'clock
    - 
    - 
- Liquid Systems
  - Poor adhesion
    - 
  - Mis-metering
    - 
  - Sagging
    - 

Adhesion mechanisms

- Mechanical
- Chemical
- Dispersive
- Electrostatic
- Diffusive



The need of surface preparation is different by adhesive technology

… or even by viscosity

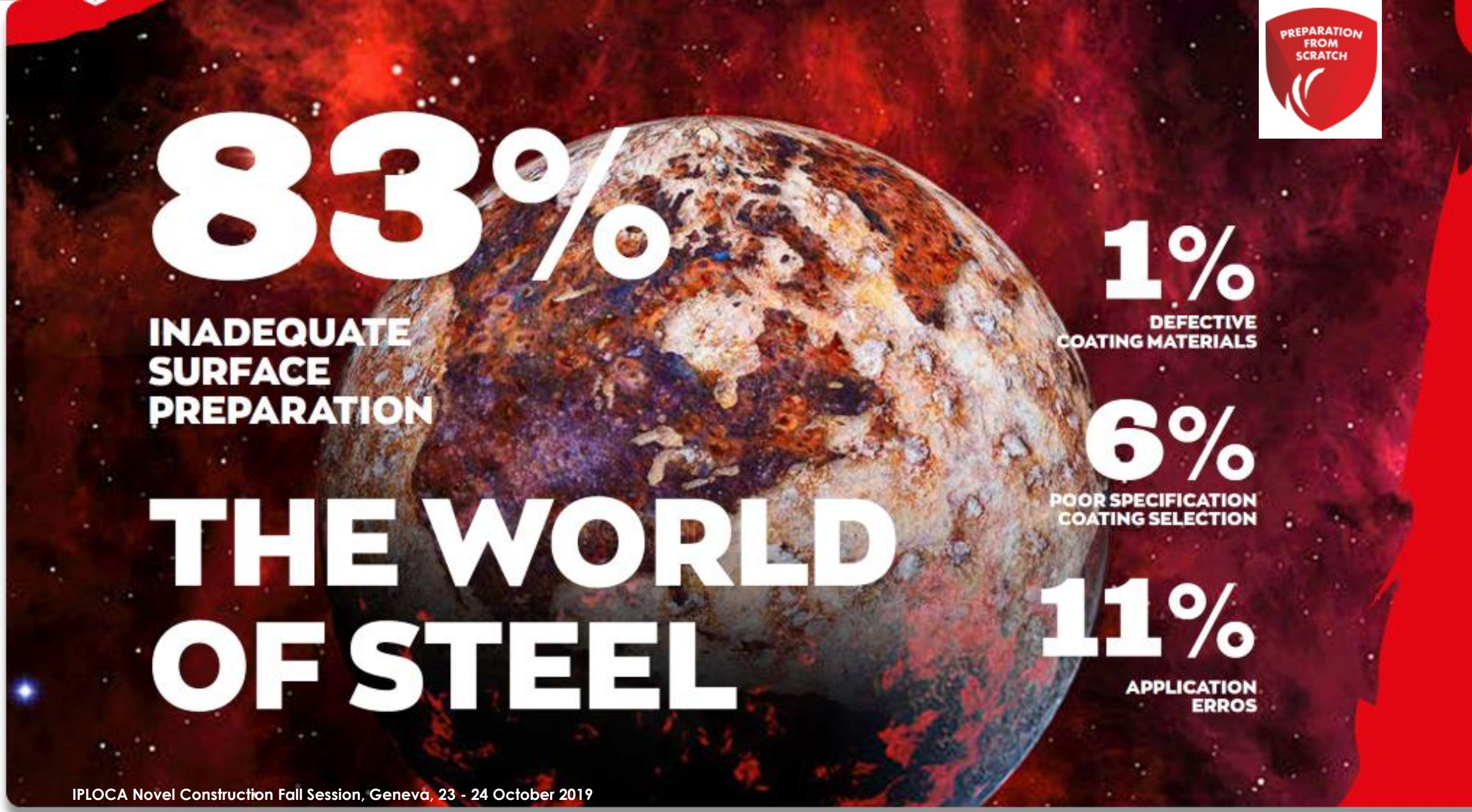
- Epoxy coatings
- Zinc coatings
- Polyurethane coatings
- Acrylic coatings
- Thermal Spray Alu Coating
- Butyl Rubber adhesive coating systems
- PIB-based coating systems
- Wax-based coating systems
- Bitumen Coatings
- etc.…

Mechanical adhesion…

MECHANICAL INTERLOCKING OR KEEPING TWO SOLIDS IN CONTACT

The impact of Surface Preparation Method on Coating Performance

Majority of the coatings still used today rely on mechanical adhesive mechanisms


PREPARATION FROM SCRATCH
83%
INADEQUATE SURFACE PREPARATION
1%
DEFECTIVE COATING MATERIALS
6%
POOR SPECIFICATION COATING SELECTION
11%
APPLICATION ERROS
THE WORLD OF STEEL

Onshore field joints

- Abrasive
- Compressors
- Abrasive blast units
- Disposal

Offshore field joints

- Space and weight
- Waste management
- Confined space

What are we looking for?

A replacement of abrasive blasting

- Water jetting – HPWJ, UHPWJ
- Vapor blasting
- Laser cleaning
- Bristle blasting

Hand tools

- Poor profile
- Does not remove millscale

So, for instance by a wirebrush.

Handtool

Visual standard conformance

These coatings manufacturers claim this for complete rehab work

Power tools

- For instance a grinder or rotating brush
- Powertool – uses an external power source
- Poor profile and burnishing

Most commonly used method is still abrasive blasting, since 1800s

Effects of profile and peak density

- Pressure
- Media
- Angularity

PREPARATION FROM SCRATCH

Surface Preparation Standards

- Surface preparations standards exist to maximize coating life and minimize costs.
- Surface prep accounts for up to 40% of the cost of a recoat job, asset owners look save cost and time.

note… Rust does have a kind of profile and remains are seen as contamination interfering with adhesion

Standards descriptions

- Mill scale
- Loose rust
- Visible contaminants

- **Solvent Cleaning SSPC-SP1 Definition:** Solvents such as water, mineral spirits, xylol, toluol etc., are used to remove solvent-soluble foreign matter from the surface of ferrous metals. Rags and solvents must be replenished frequently to avoid spreading the contaminant rather than removing it. Low-pressure (1500 - 4000 psi) high volume (3 - 5 gal/min.) water washing with appropriate cleaning chemicals is a recognized "solvent cleaning" method. All surfaces should be should be cleaned per this specification prior to using hand tools or blast equipment.

- **Hand Tool Cleaning SSPC-SP2 (SSI-St3) Definition:** A mechanical method of surface preparation involving wire brushing, scraping, chipping and sanding. Not the most desirable method of surface preparation, but can be used for mild exposure conditions. Optimum performances of protective coatings should not be expected when hand tool cleaning is employed.

- **Power Tool Cleaning SSPC-SP3 (SSI-St3) Definition:** A mechanical method of surface preparation widely used in industry and involving the use of power sanders or wire brushes, power chipping hammers, abrasive grinding wheels, needle guns etc. Although usually more effective than hand tool cleaning, it is not considered adequate for use under severe exposure conditions or for immersion applications.

- **White Metal Blasting SSPC-SP5 (SSI-Sa3), or NACE #1 Definition**: The removal of all visible rust, mill scale, paint and contaminants, leaving the metal uniformly white or gray in appearance. This is the ultimate in blast cleaning. Use where maximum performance of protective coatings is necessary due to exceptionally severe conditions such as constant immersion in water or liquid chemicals.

- **Commercial Blast SSPC-SP6 (SSI-Sa2), or NACE #3 Definition:** All oil, grease, dirt, rust scale and foreign matter are completely removed from the surface and all rust, mill scale and old paint are completely removed by abrasive blasting except for slight shadows, streaks or discolorations caused by rust stain, mill scale oxides or slight, tight resides of paint or coating that remain. If the surface is pitted, slight residue of rust or paint may be found in the bottom of pits; at least two-thirds of each square inch of surface area shall be free of all visible residues and the remainder shall be limited to the light residues mentioned above.

- **Brush Off Blast SSPC-SP7 (SSI-Sa1), or NACE #4 Definition:** A method in which all oil, grease, dirt, rust scale, loose mill scale, loose rust and loose paint or coatings are removed completely. Tight mill scale and tightly-adhered rust, paint and coatings are permitted to remain. However all mill scale and rust must have been exposed to the abrasive blast pattern sufficiently to expose numerous flecks of the underlying metal fairly uniformly distributed over the entire surface.

- **Brush Off Blast SSPC-SP10 (SSI-Sa2 ½), or NACE #2 Definition:** In this method, all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter have been completely removed from the surface by abrasive blasting, except for very light shadows, very slight streaks or slight discolorations caused by rust stain, mill scale oxides or slight, tight residues of paint or coating. At least 95% of each square inch of surface area shall be free of all visible residues, and the remainder shall be limited to the light discolorations mentioned above. From a practical standpoint, this is probably the best quality surface preparation that can be expected to today for existing plant facility maintenance work.

- **Power Tool Cleaning to Bare Metal SSPC-SP11 Definition:** Utilizing same equipment as Power Tool Cleaning to remove all visible coatings and contaminants to bare metal substrate.

Pictorial ISO 8501 standard…

ISO 8501 is a pictorial standard

- Sa 1 Light Blast Cleaning
- Sa 2 Thorough Blast Cleaning
- Sa 3 Blast Cleaning to Visually Clean Steel

Surface roughness comparator

- Visual

Preparation Grades depending on Media Type…

Abrasive grades are to provide roughness or anchor profile as per requirement of a coating system, mainly based on the coating system thickness

Supplement ISO 8501 Preparation grades Sa

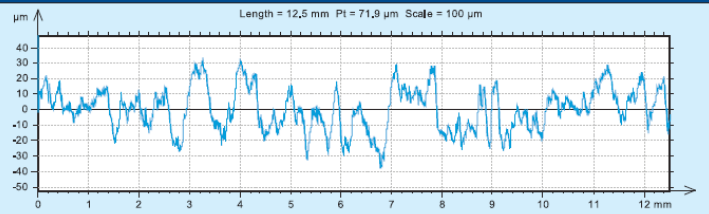
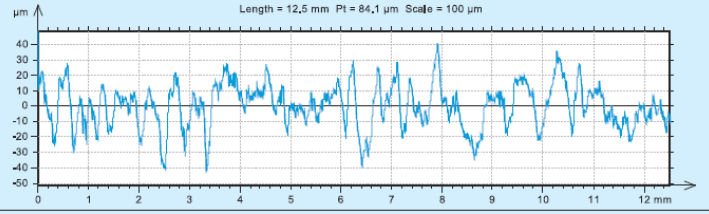
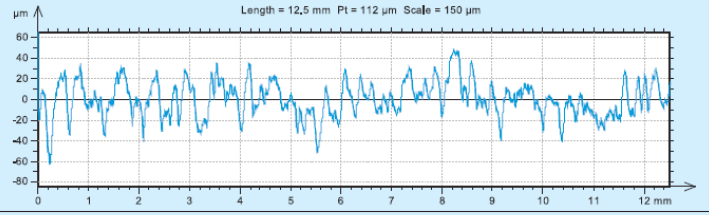
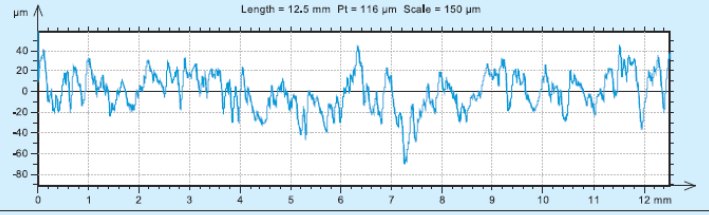
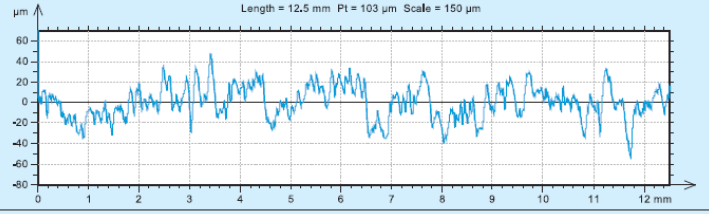
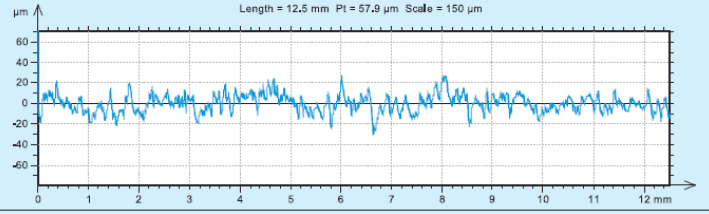
Examples of Sa 3, blasted with various abrasives

Steel plat rustgrade C	
High carbon cast steelshot S100 390 – 530 HV (vickers hardness)	
Steelgrit G070 390 – 530 HV	
Steelgrit G070 700 – 950 HV	
Chilled iron grit G070	
Copperslag grit	
Coalslag grit	

Results

- „WELDING“ JOURNAL FOR WELDING AND ALLIED TECHNIQUES
- B. Miketic, I. Stojanovic

Tablica 5. Grafički prikaz rezultata mjerenja hrapavosti površine uzoraka
Table 5. Chart of roughness measurement on sample surface

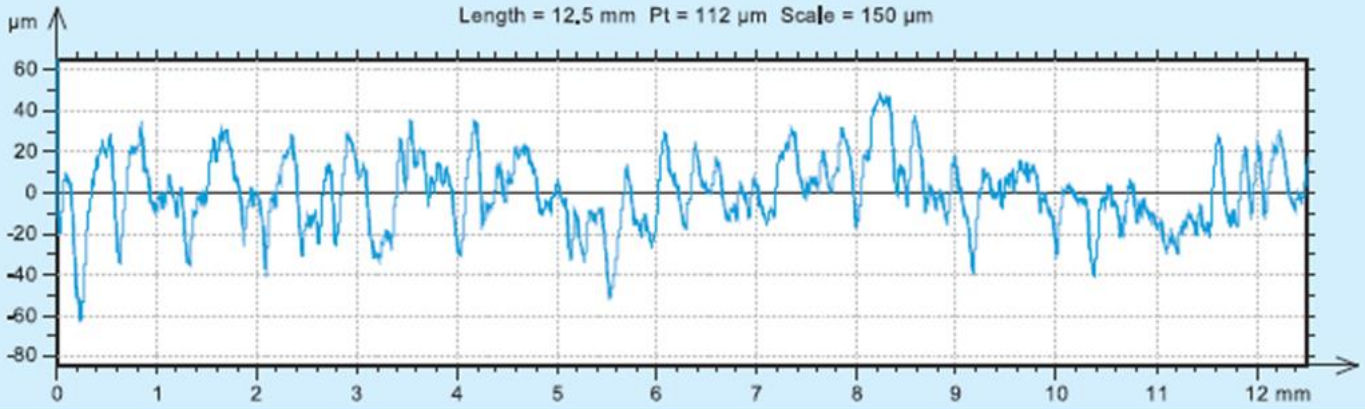
UZORAK	GRAFIČKI PRIKAZ
4 – KORUND (4 bar) R_p 16,6 µm R_v 16,6 µm R_z 33,2 µm R_a 6,66 µm R_{sm} 0,210 mm	
6 – KORUND (6 bar) R_p 18,7 µm R_v 20,9 µm R_z 39,5 µm R_a 8,12 µm R_{sm} 0,192 mm	
14 – ČELIČNA SAČMA (6 bar) R_p 23,6 µm R_v 28,0 µm R_z 51,7 µm R_a 9,96 µm R_{sm} 0,226 mm	
18 – ČELIČNA SAČMA (4 bar) R_p 21,9 µm R_v 24,7 µm R_z 46,6 µm R_a 8,65 µm R_{sm} 0,184 mm	
22 – KVARCNI PIJESAK (4 bar) R_p 21,3 µm R_v 22,3 µm R_z 43,7 µm R_a 8,32 µm R_{sm} 0,173 mm	
26 – KVARCNI PIJESAK (6 bar) R_p 15,3 µm R_v 16,0 µm R_z 31,3 µm R_a 5,21 µm R_{sm} 0,139 mm	

R_p – najveća visina vrha profila
R_v – najveća dubina dola profila
R_z – najveća visina profila
R_a – srednje aritmetičko odstupanje profila

PREPARATION FROM SCRATCH

14 – ČELIČNA SAČMA
(6 bar)

R_p	23,6	µm
R_v	28,0	µm
R_z	51,7	µm
R_a	9,96	µm
R_{sm}	0,226	mm



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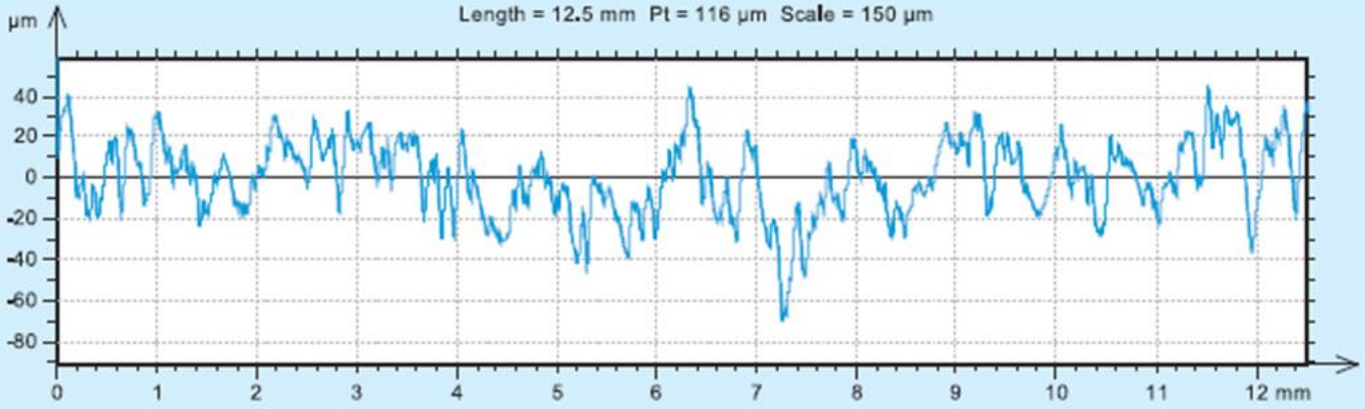
(4 bar)

R_p	21,9	µm
R_v	24,7	µm
R_z	46,6	µm
R_a	8,65	µm
R_{sm}	0,184	mm

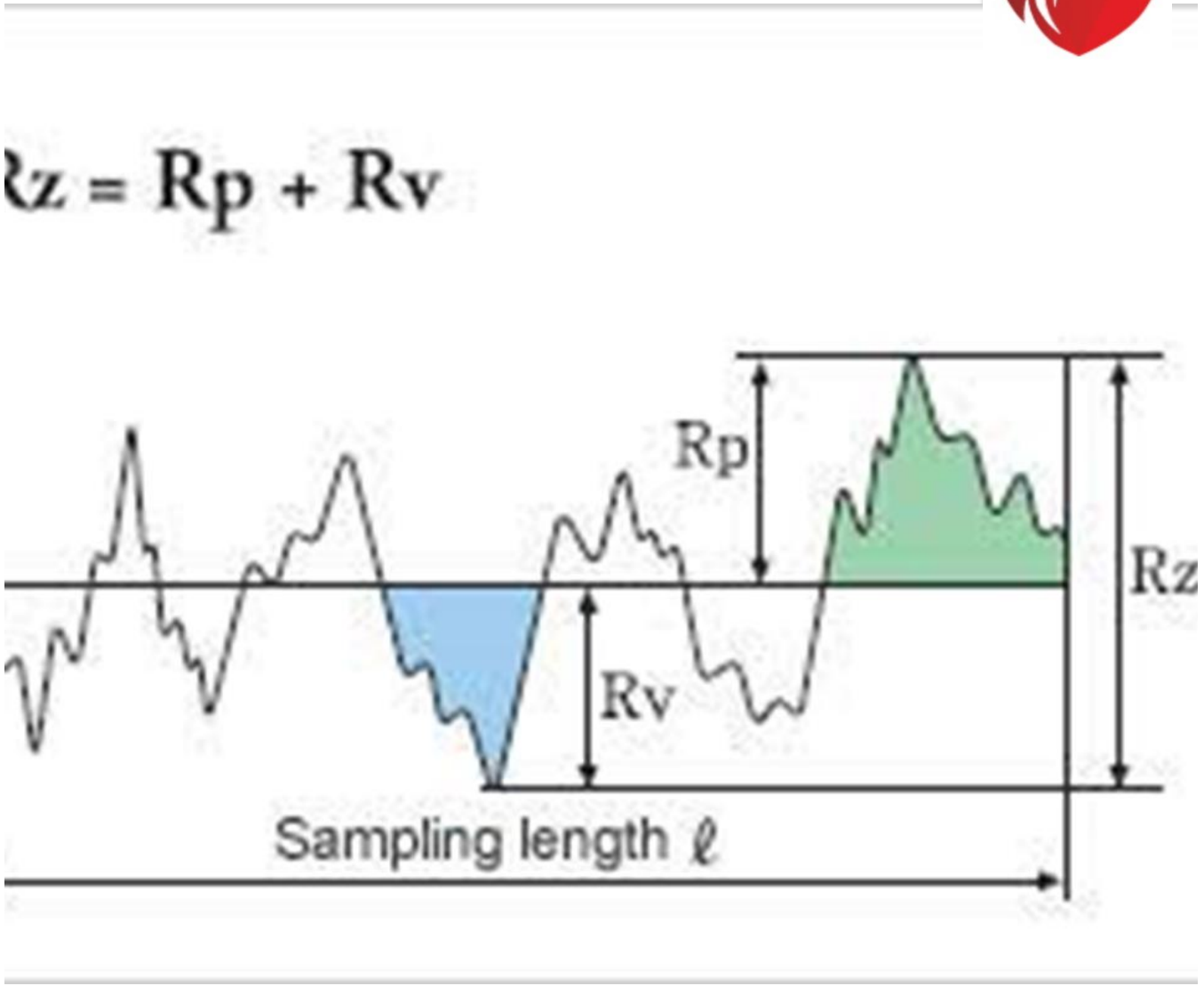


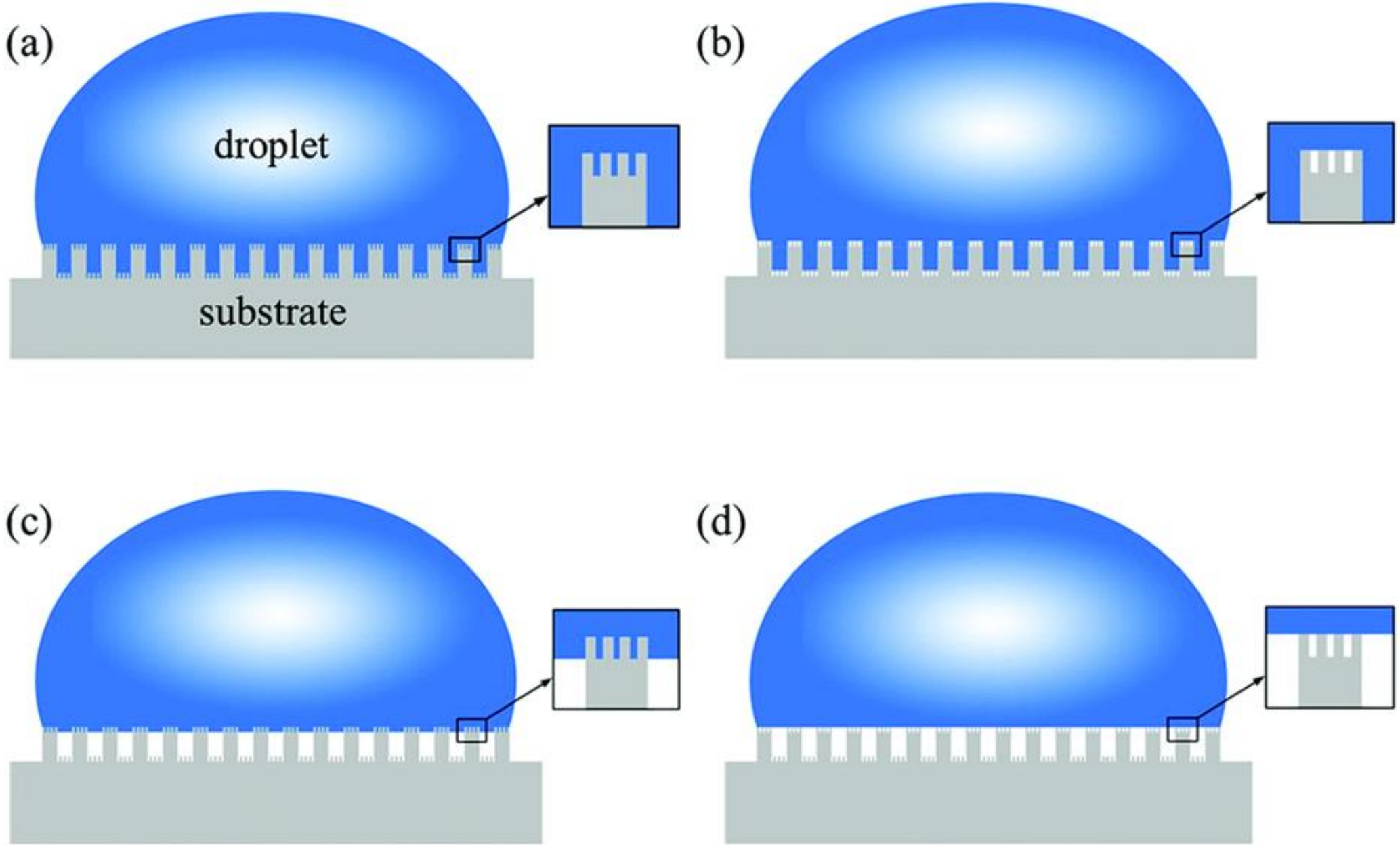
Results…

CHILLED IRON GRIT – PROFILE AMPLITUDE

What is the objective for profiling?

- Increasing the surface area – more to cover
- Mechanical bond – anchoring or interlocking
- Reduce coating stress during curing and aging - contraction



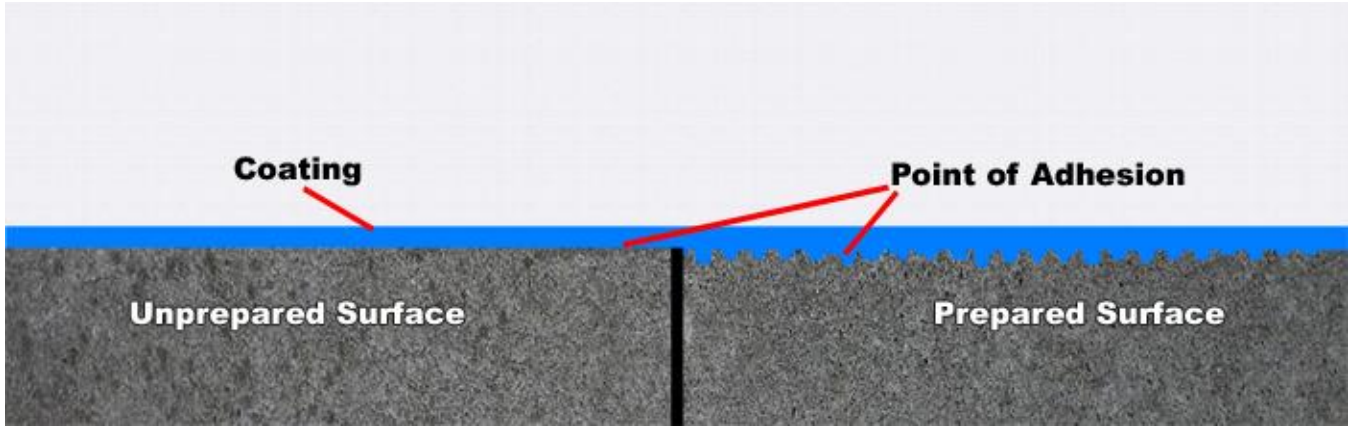

(a)
droplet
substrate
(b)
(c)
(d)

Service Life Expectancy…

Is there a Correlation?

Anchor Pattern or Surface Profile

- Improves the mechanical bonding or interlocking of a coating to the surface by increasing the surface area.



Best coating in the field

- Long term barrier properties and self repair allowance
- Exhibit durable adhesion (questioning the type of adhesion) to the substrate
- It must be resistant to cathodic disbondment, if applicable, within defined limits.

Some paint manufacturers say…

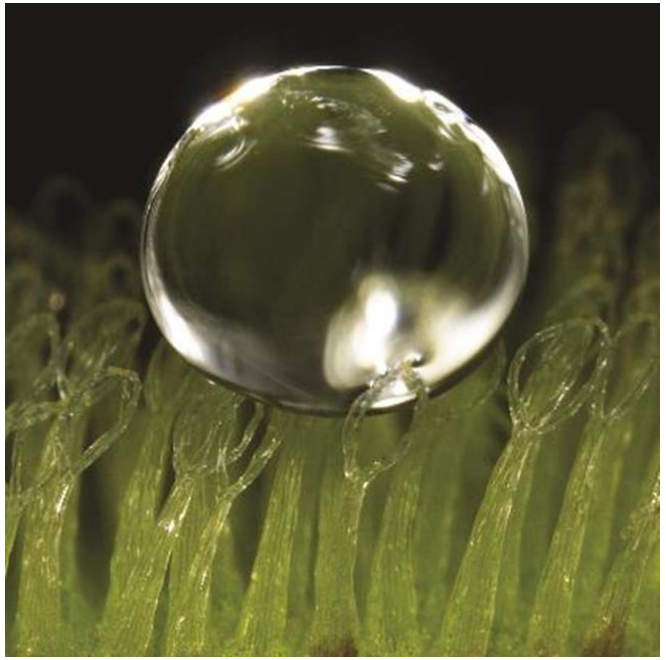
`there is no correlation between surface prep and coating performance`

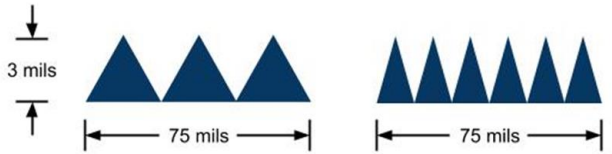
Is this true or false and does it depend on the point of view of the contractor being the applicator?

How do you measure desired performance in surface prep?

ISO 21809-3 FIELD JOINT COATING

- Density by Rpc?
- Angularity by Ra?
- Regularity by Rz?





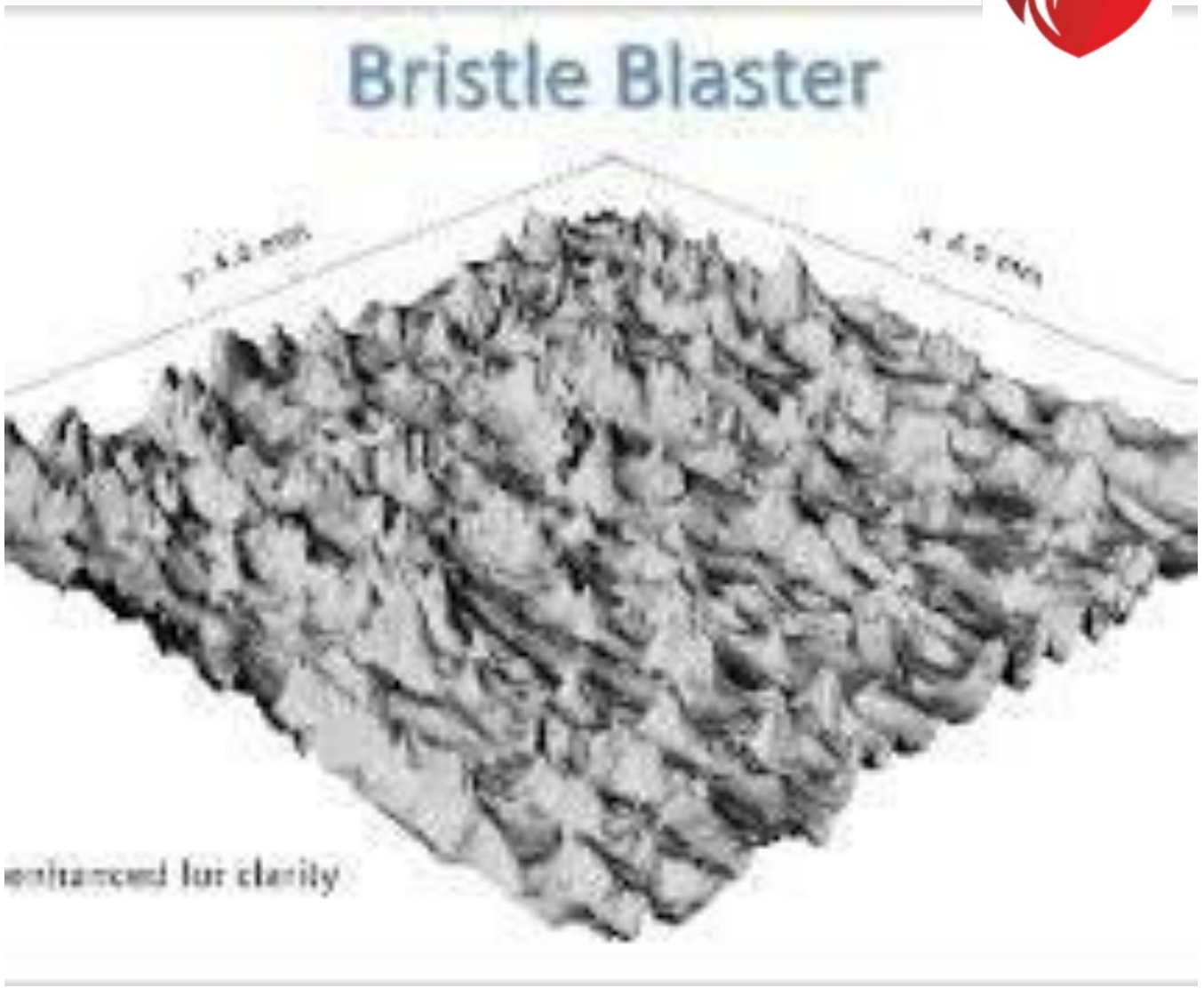
Method of ´Bristle Blasting´

- Certainly cleaner than St2-3, and similar to SA3
- Always above 50 Micron Rz with various amount of Rpc, or Ra
- Pre determine the anchor profile, peaks and valleys as well as the peak density as per coating viscosity

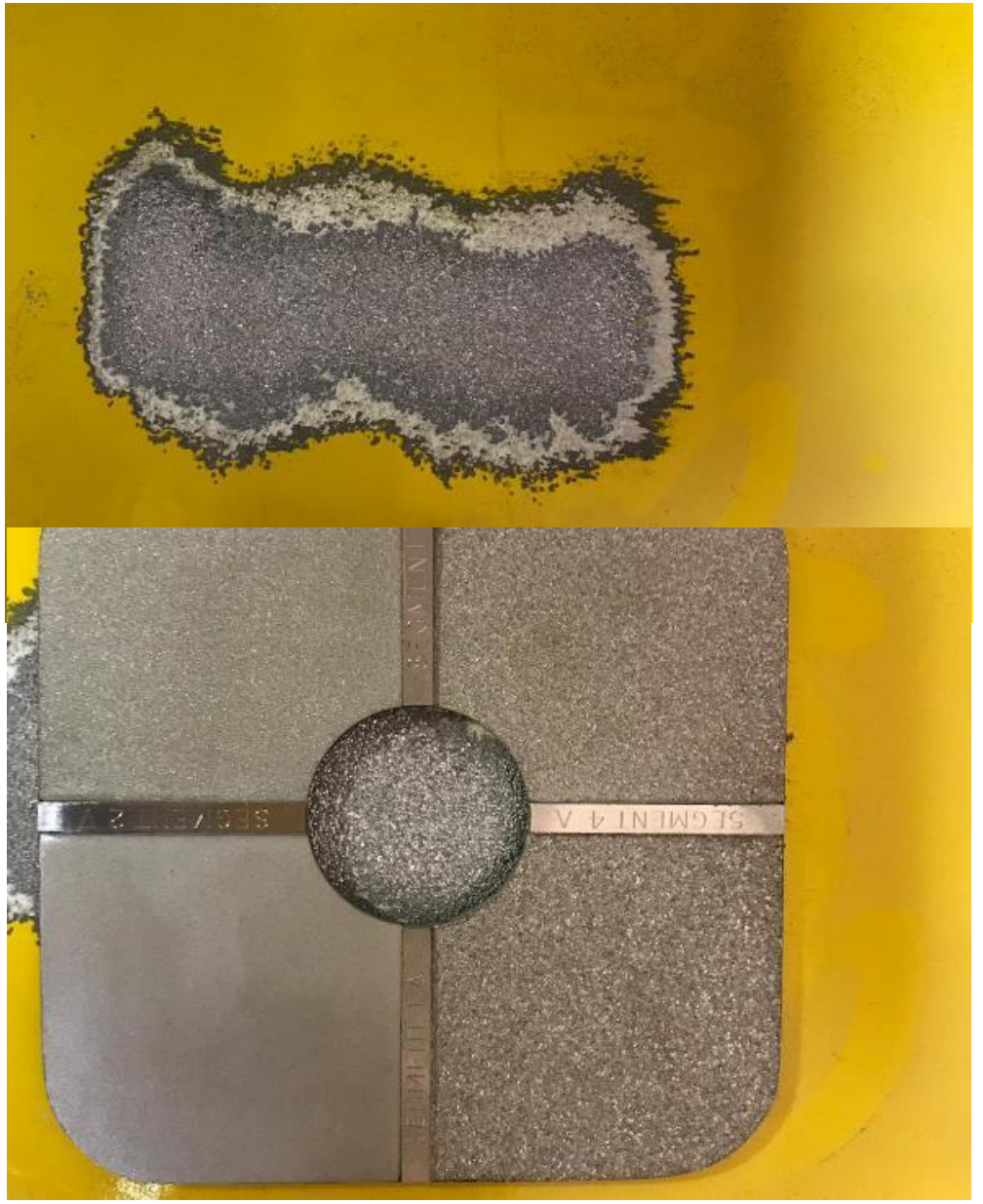
IT IS JUST A DIFFERENT METHOD

Bristle blasting

- Profile and peak density

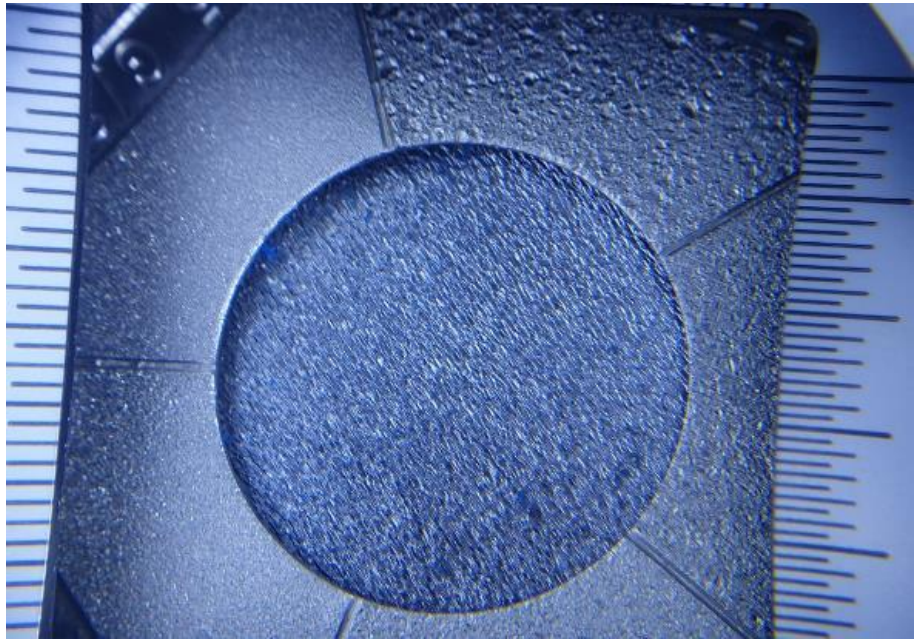


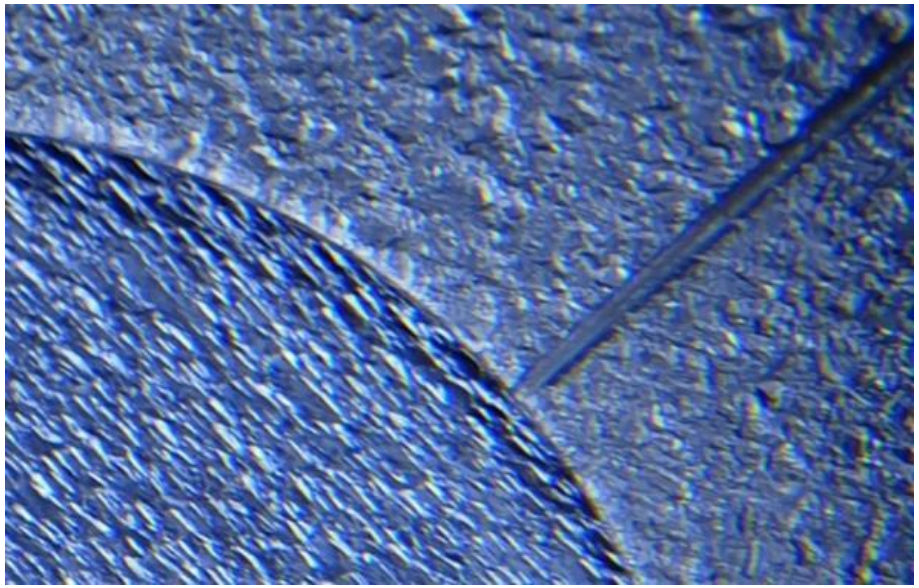
Bristle blasting…



AMI Field Joint Coating, London, 2019

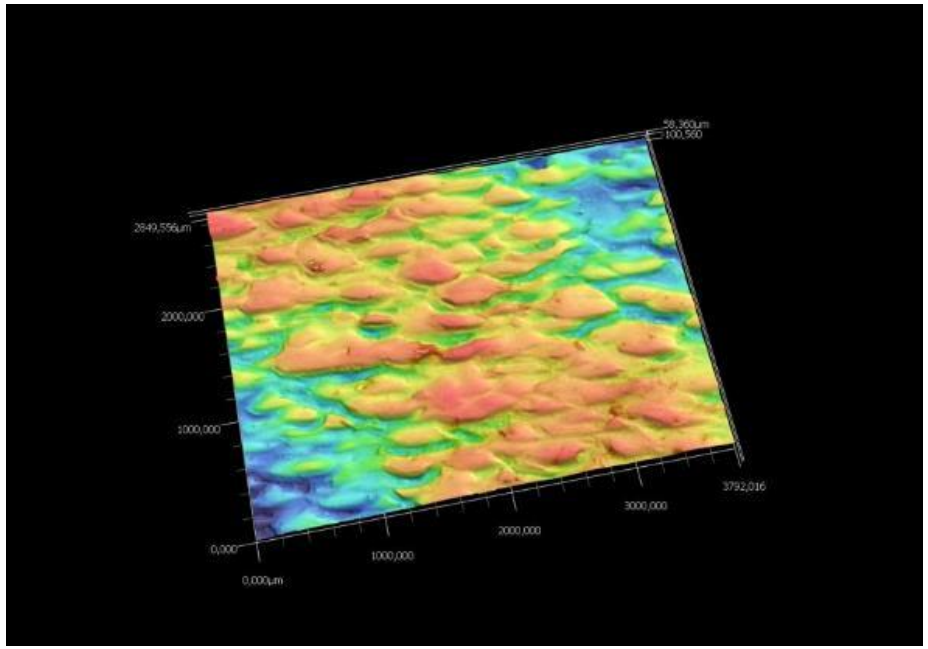
Bristle blasting…

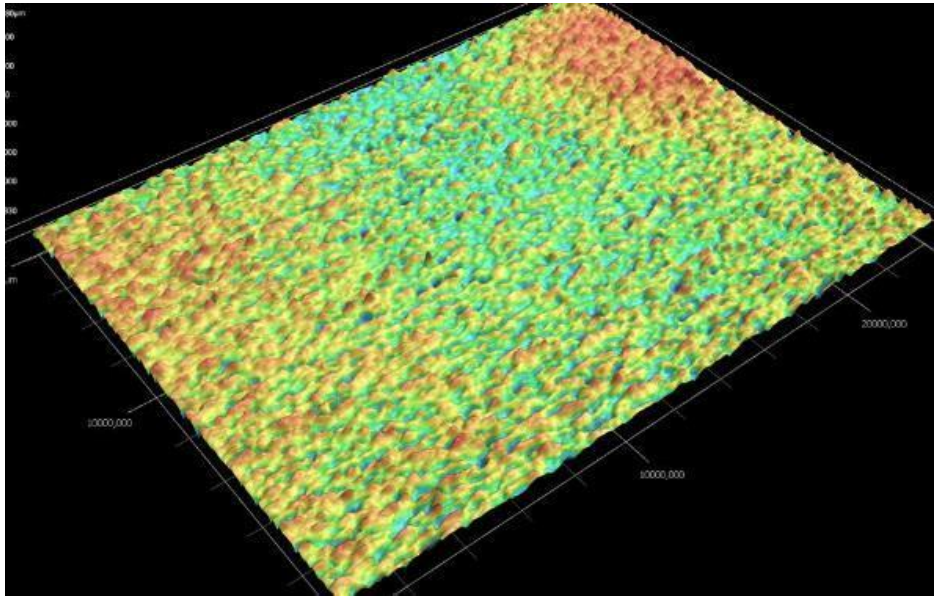




AMI Field Joint Coating, London, 2019

Wetting…





AMI Field Joint Coating, London, 2019

Target to achieve best coating performance?

- Energy efficiency
- Cost efficiency
- No impact to the environment
- No H&S risk dust control
- No change in steel (stress)
- No waste management
- Constant RZ profile
- No confusion about prep quality for coating performance

Question?

Why does abrasive blasting as a general term, not just a method, exist in the standards?

The definition should be specific to the profile design relevant to the coating defined by best performance based on the coating 'wettability' (surface tension) and its viscosity.

It should not be about a specific tool on how to achieve the goal but just about the goal and its definition!!!

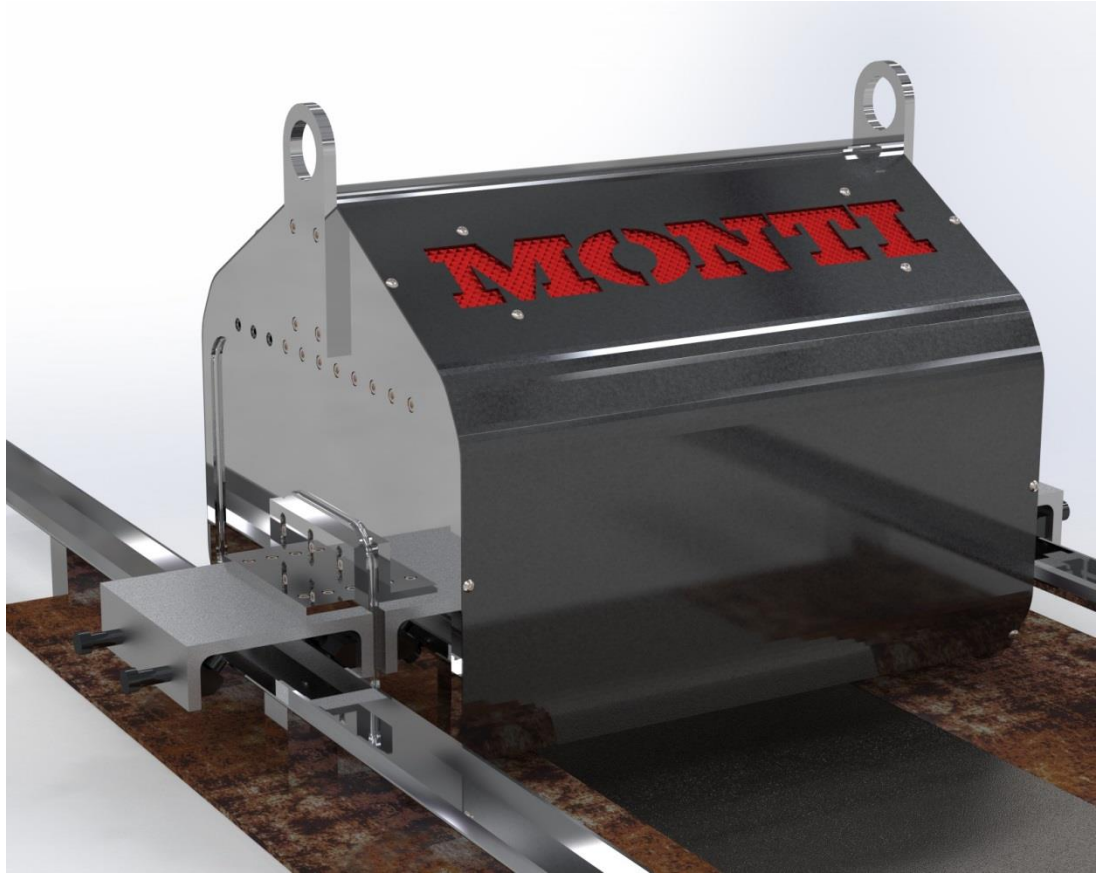
Innovation

"The electric light did not come from continuous improvement of candles"

Oren Harari

The Prepper

Rail guided




PREPARATION
FROM
SCRATCH


PREPARATION
FROM
SCRATCH


PREPARATION FROM SCRATCH
1 47 µM
2800 RPM
5KG
2 85 µM
2800 RPM
5KG
3 57 µM
3000 RPM
5KG
4
3000 RPM
5KG

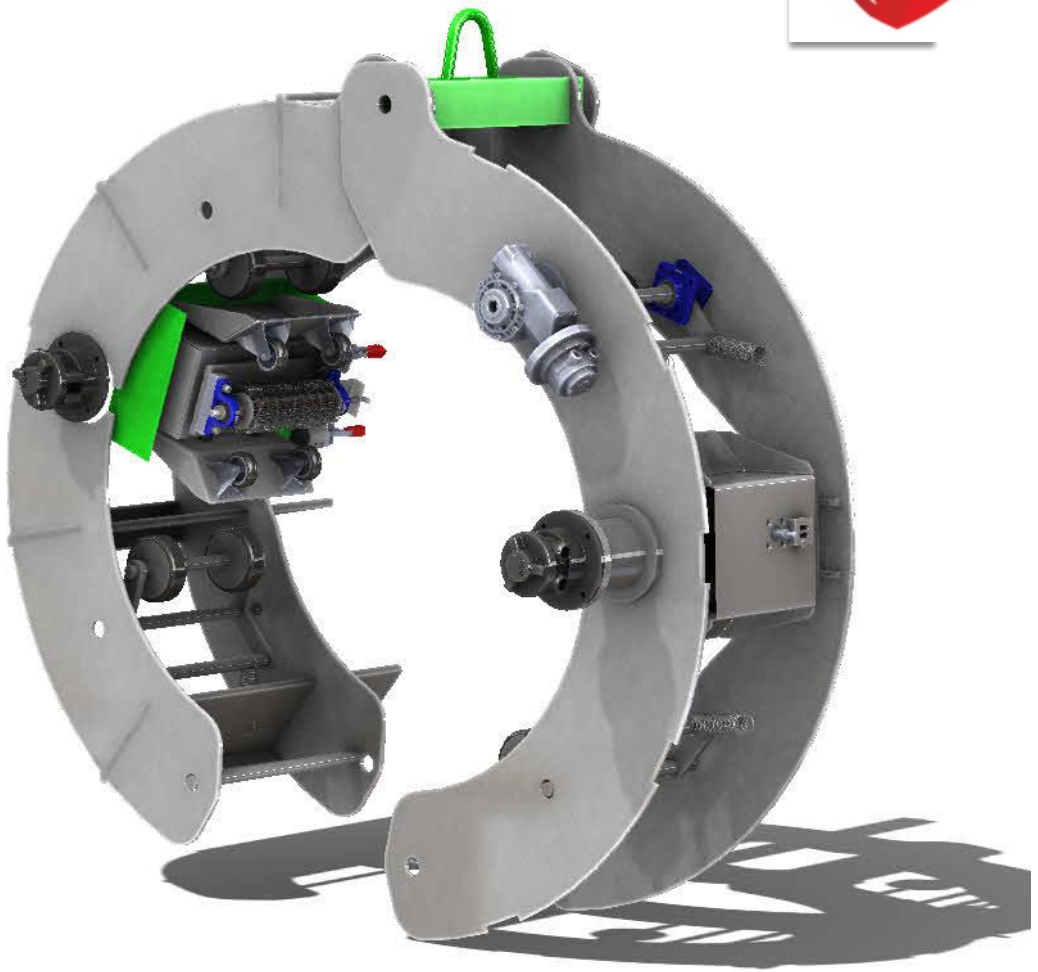
PREPARATION FROM SCRATCH

The Prepper

The Prepper

Cleantech Prepper

- Pipe size: 48”
- Cutback: 300mm (1.15m2)
- Speed: 127 seconds



PREPARATION FROM SCRATCH

THE MBX®

ADVANTAGE

- Rapidly removes corrosion and oxidation – both hard and soft material
- Performs on uneven surfaces
- Highly flexible in tight areas
- No clogging or gumming of bristles
- No grinding or removal of substrate material
- Efficient cutting action – creates angular profile
- Cleans surfaces evenly
- Full visibility of work surface
- No heat development
- Long performance life and low cost of operation
- High safety level

SELECTED MBX®

APPLICATIONS

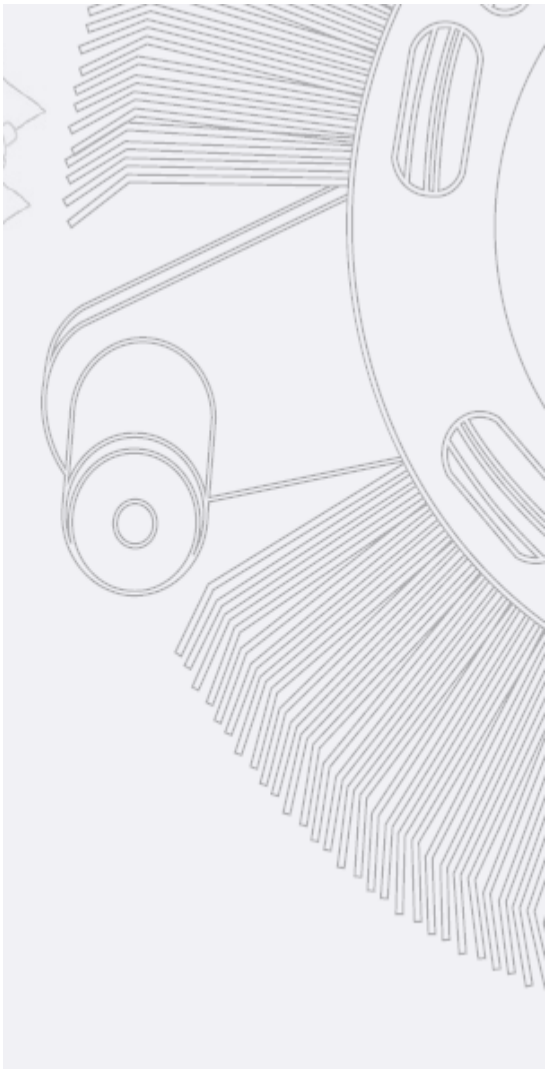
- Removing corrosion and oxidation, rust and scale
- Removing paint, protective coatings and sealers
- Removing vinyl, decals, reflective tape and adhesives
- Removing slag and weld burn, decontaminating metal surfaces
- Creating surface textures - from sharp, angular profiles to smooth finish
- Feathering into existing coatings
- Roughing fiberglass, plastic or rubber surfaces for repair or bonding
- Removing residue from industrial, manufacturing or construction operations

THE MBX®

TECHNOLOGY

- The flexible-wire belts rotate in a patented housing, spinning outward with centrifugal force and working on a cushion of air
- Specially designed bristles are U-shaped staples inserted through a durable nylon belt and provide safe, long lasting performance
- Bristle tips have a positive rake angle, striking the surface and rebounding in a chiseling action– removing surface coatings and scale but not substrate material
- Bristle tips are hardened and ground sharp to effectively remove both hard and soft material and create textured surface profiles
- The toothed-wheel design of the eraser enables it to grab the edges of applied vinyl, peeling it from the surface without paint damage or residue

PREPARATION FROM SCRATCH



- Low vibration levels
- Easy and safe handling
- U-shaped, anchored wires
- Low sound pressure level of max. 83 dB(A)
- Low rotational speed of max. 3,500 rpm

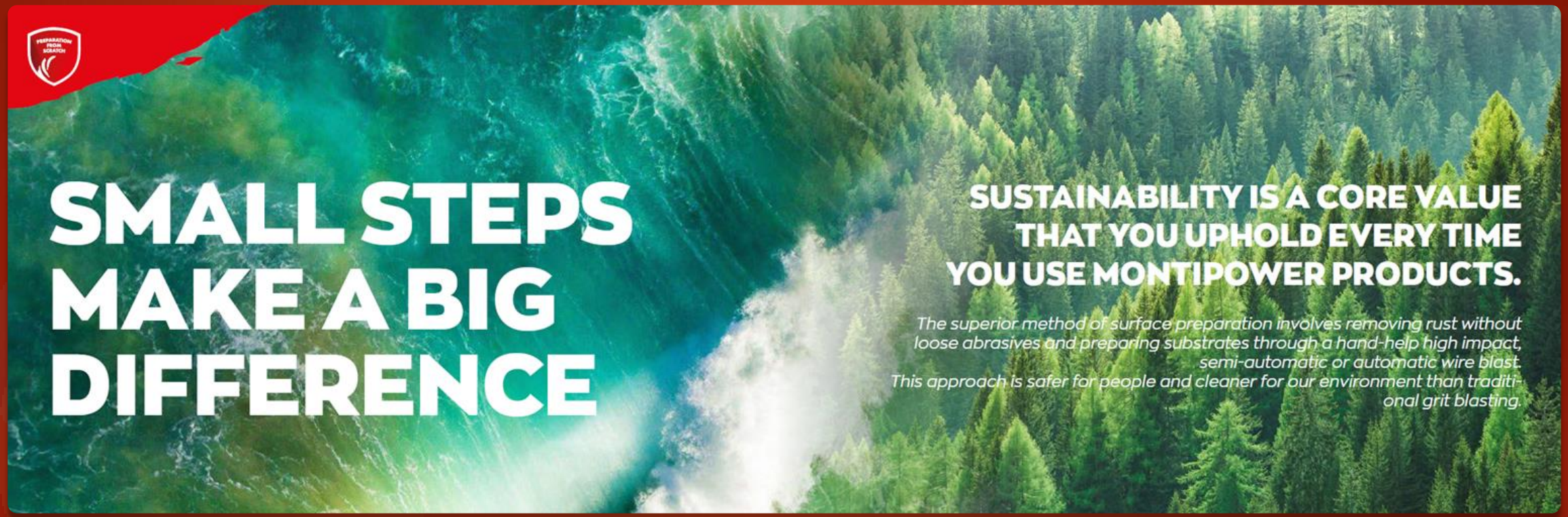
- Removes rust, paint, underseal and sealants
- Greater adaptability to contoured areas
- Minimal loss of base material
- No smearing and gumming up thanks to minimal generation of heat

Why and how??

- Uniform Roughness Profile with constant designed peak height and density
- Oscillating brushes enabling uniform and optimal surface coverage
- Adjustable accelerator bar enables changes to roughness profile
- Process monitoring and auto-adjustment through laser and sensors
- Programmable profile and amplitude selector
- Minimal logistic interventions
- Programmable via smart phone app
- Up to 4x faster than conventional blasting
- Device scalable to larger units
- Recyclable brushes
- Built in dust collection
- Low energy consumption
- Rental options

Technology	Abrasive blasting	Manual handtool	Cleantech Prepper
Mode of operation	Manual / Automated	Manual	Automated
Cleaning impact	High	Low	High
Cleaning speed	High	Slow	High
Consumables and waste	High	High	Low
Repeatability / profile	Mid	Low	High
Profile precision	High	Medium	High
EHS (dust free)	No (optional extra)	No	Yes
Cost to operate	High	Low	Low
Power requirements	High	Low	Low
Equipment footprint	Large	Small	Small
PPE / HSE impact	High	High	Low

Comparison


SMALL STEPS
MAKE A BIG
DIFFERENCE
SUSTAINABILITY IS A CORE VALUE
THAT YOU UPHOLD EVERY TIME
YOU USE MONTIPOWER PRODUCTS.
The superior method of surface preparation involves removing rust without loose abrasives and preparing substrates through a hand-help high impact, semi-automatic or automatic wire blast.
This approach is safer for people and cleaner for our environment than traditional grit blasting.

PREPARATION FROM SCRATCH

Coating is only as good as the surface preparation and application

MONTIPOWER

Surface Preparation Technologies

Part of Monti Group

PREPARATION FROM SCRATCH

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Surface Preparation Technologies
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QUALITY MADE IN GERMANY SINCE 1987