A Different Way to Look at Surface Preparation

1

A Different Way to Look at Surface Preparation

- Dry Abrasive Blasting has been the primary method of surface preparation employed by most in the coating industry.
- The first abrasive blasting process was patented by ***Benjamin Chew Tilghman*** on 18 October 1870.

2

What Standard Organizations Govern Surface Preparation

- The major organizations that pioneered surface preparation standards in our industry have been
- NACE (National Association of Corrosion Engineers) formed in 1943.
- ISO (International Standards Organization) formed 23 Feb 1947.
- SSPC (The Steel Structures Painting Council) formed in 1950.
  - January 1, 2021. NACE and SSPC merged and AMPP was created.

AMPP™

ISO

SSPC™ The Society For Protective Coatings

NACE® INTERNATIONAL

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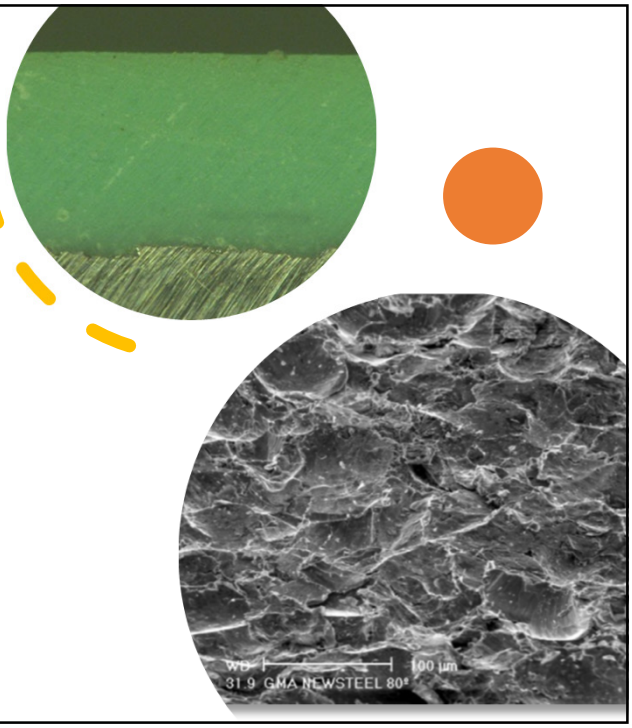
What's is Surface Preparation

Simply, it's preparing the surface to accept a coating or other operations.

Two essential parts of Surface Preparation are

Surface Cleanliness	Surface Profile



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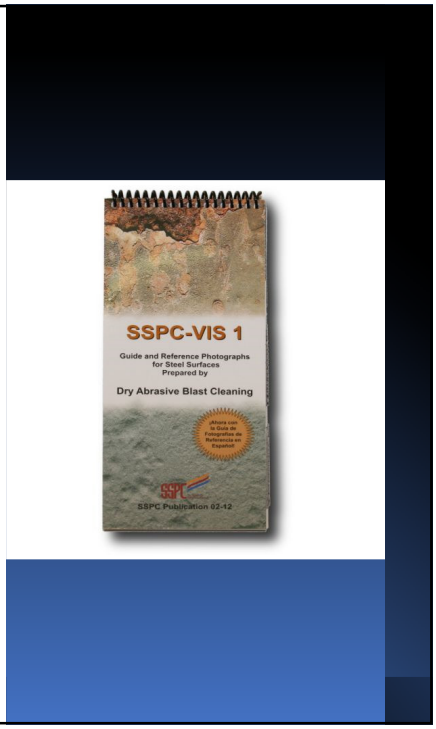
Surface Cleanliness versus Surface Profile

- Surface Cleanliness
  - Ensuring that the surface to be coated is clean
    - Free from visible and non-visible contaminants
    - Standards for different methods of cleaning the surface
      - ISO SA & ST Standards
      - NACE/SSPC Joint Standards
      - SSPC Cleaning, Hand and Power Tool Standards



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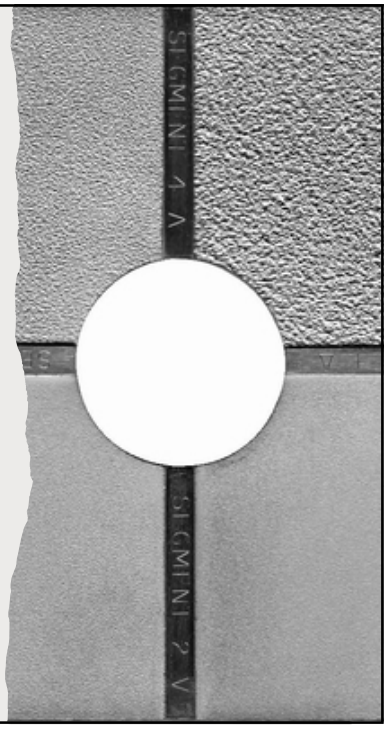
Surface Cleanliness versus Surface Profile

- Surface Profile (sometimes referred to as “Anchor Profile”
  - Surface profile refers to the contour or roughness of the surface.
  - This surface roughness has a number of functions
    - Increases the bonding surface area to which the coating can adhere
    - Affects adhesion of the coating to the substrate
    - Affects the coverage of the coating
    - Affects the volume of the coating used



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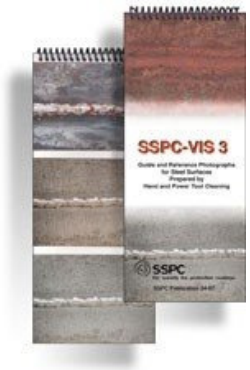
What's Are The Current Standards For Power Tools?

- Are there any standards that require a specific surface profile?
  - SSPC SP 11 Power Tool Cleaning to Bare Metal
    (Section 2.1.1 - requires a minimum of 1 mil profile)
  - SSPC SP 15 Commercial Grade Power-Tool Cleaning
    (Section 2.5 - requires a minimum of 1 mil profile)
  - SSPC SP 16 Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
    (Section 2.1 requires a minimum of .75 mil profile)



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What's Are The Current Standards For Power Tools?

- ISO 8501 -1 Cleaning Standard
  - ST 2 Thorough Hand and Power Tool Cleaning
  - ST 3 Very Thorough Hand and Power Tool Cleaning

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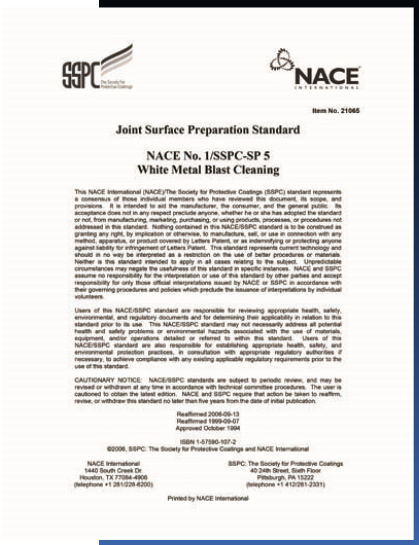
What's Are The Current Cleanliness Standards For Abrasive Blasting?

- SSPC SP 5/NACE 1, White Metal Blast Cleaning
- SSPC SP 10/NACE 2, Near-White Metal Blast Cleaning
- SSPC SP 6/NACE 3, Commercial Blast Cleaning
- SSPC SP 14/NACE 8, Industrial Blast Cleaning
- SSPC SP 7/NACE 4, Brush-Off Blast Cleaning
    - Do these standards require a specific surface profile?



SSPC NACE INTERNATIONAL

Item No. 21065

Joint Surface Preparation Standard

NACE No. 1/SSPC-SP 5
White Metal Blast Cleaning

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What's Are The Current Cleanliness Standards For Abrasive Blasting?

- Cleanliness Standards
    - ISO SA 1 Light Blast Cleaning
    - ISO SA 2 Thorough Blast Cleaning
    - ISO SA 2 ½ Very Thorough Blast Cleaning
    - ISO SA 3 Blast Cleaning to Visually Clean Steel

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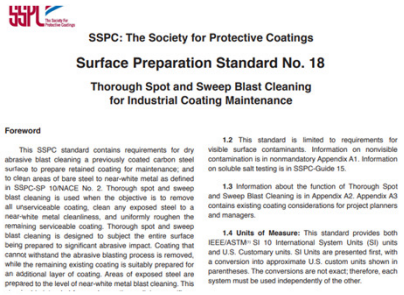
What are some of the Newer Surface Preparation Standards & Methods?

- Standards
- Technology & Equipment



SSPC: The Society for Protective Coatings

Surface Preparation Standard No. 18

Thorough Spot and Sweep Blast Cleaning for Industrial Coating Maintenance

Foreword

This SSPC standard contains requirements for dry abrasive blast cleaning a previously coated carbon steel surface to prepare retained coating for maintenance; and to clean areas of bare steel to near-white metal as defined in SSPC-SP 10/NACE No. 2. Thorough spot and sweep blast cleaning is used when the objective is to remove all unserviceable coating, clean any exposed steel to a near-white metal cleanliness, and uniformly roughen the remaining serviceable coating. Thorough spot and sweep blast cleaning is designed to subject the entire surface being prepared to significant abrasive impact. Coating that cannot withstand the abrasive blasting process is removed, while the remaining existing coating is suitably prepared for an additional layer of coating. Areas of exposed steel are prepared to the level of near-white metal blast cleaning. This

1.2 This standard is limited to requirements for visible surface contaminants. Information on nonvisible contamination is in nonmandatory Appendix A1. Information on soluble salt testing is in SSPC-Guide 15.

1.3 Information about the function of Thorough Spot and Sweep Blast Cleaning is in Appendix A2. Appendix A3 contains existing coating considerations for project planners and managers.

1.4 Units of Measure: This standard provides both IEEE/ASTM® SI 10 International System Units (SI) units and U.S. Customary units. SI Units are presented first, with a conversion into approximate U.S. custom units shown in parentheses. The conversions are not exact; therefore, each system must be used independently of the other.

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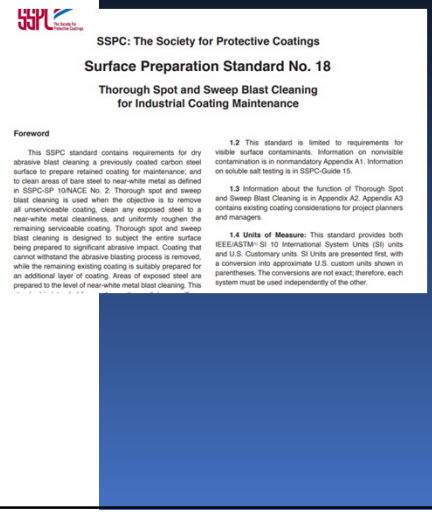
What's the latest standard in Surface Preparation?

- **Standards**
  - The latest new standard published is
  - SSPC SP 18 Thorough Spot and Sweep Blast Cleaning for Industrial Coating Maintenance.
    - "Thorough spot and sweep blast cleaning is used when the objective is to remove all unserviceable coating, clean any exposed steel to a near-white metal cleanliness, and uniformly roughen the remaining serviceable coating."
    - Areas cleaned to SSPC SP10/NACE 2: Unserviceable coating
    - "Sweep Blasting: A fast pass of the abrasive blasting pattern over a surface to remove loose material and to roughen the surface sufficiently to successfully accept a coat of paint." (SSPC SP 18)



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What's Newest Abrasive Blasting Technologies to address environmental issues in Surface Preparation?

- Blasting Technology
  - Vapor Blasting
    - Vapor blasting has been successfully used to reduce the dust inherent in dry abrasive blasting operations.
    - Lead containment

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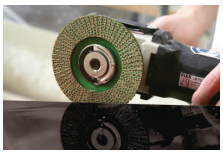
What's The Current Technology in Power Tool Cleaning?

- Power Tools
  - Needle Guns
  - Grinders
  - Roto Peens
  - Flapper Discs
  - Bristle Blaster
- Limitations of Power Tool Cleaning
  - Lack or limited profile
  - Type of profile
  - "Peak Density"
  - "Angularity"
- The market is driving the technology due to requirements for more environmentally friendly solutions.



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What Field Measurements Do We Record Today?

- There are currently two (2) industry standards that we reference/use in the field today.
  - ASTM D4417 Standard Test Method for Field Measurement of Surface Profile of Blasted Cleaned Steel.
    - Method A – Surface Comparators
    - Method B – Surface Profile Depth Micrometers
    - Method C – Replica Tape
  - ASTM D7127 Standard Test Method for Measurement of Surface Roughness of Abrasive Blast Cleaned Metal Surfaces Using a Portable Stylus Instrument.

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Measuring Surface Profile

- ASTM D4417 Standard Test Method for Field Measurement of Surface Profile of Blasted Cleaned Steel.
  - Method A – Surface Comparators
    - This method uses surface comparators or replicas are placed on the blasted surface so the operator can observe and record the achieved surface profile. (Not commonly used in North America).

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Measuring Surface Profile

- ASTM D4417 Standard Test Method for Field Measurement of Surface Profile of Blasted Cleaned Steel.
  - Method B – Surface Profile Depth Micrometers
    - A depth micrometer uses a flat base that rests on the peaks of the surface profile & a spring-loaded probe tip mounted inside the base which drops into the valleys of the profile. The flat base rests on the highest peaks & each measurement is therefore the distance between the highest local peaks and the particular valley into which the tip has projected.

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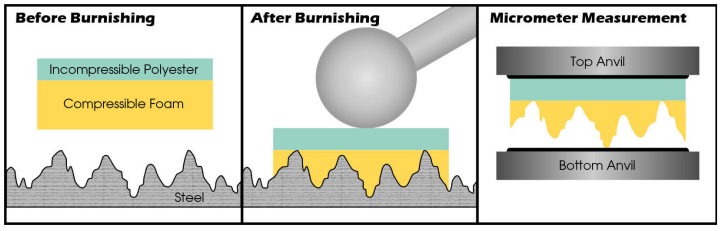
Measuring Surface Profile

- ASTM D4417 Standard Test Method for Field Measurement of Surface Profile of Blasted Cleaned Steel.
  - Method C – Replica Tape
    - Replica tape consist of a layer of crushable plastic foam attached to a non-compressible polyester substrate of a highly uniform thickness. When pressed against a roughened steel surface, the foam forms an impression, or reverse replica, of the surface. Therefore, as the highest peaks on the original surface push up to the polyester backing, the fully compressed foam is displaced sideways. Likewise, the deepest valleys on the original create the highest peaks in the replica.



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Measuring Surface Roughness

- ASTM D 7127 Standard Test Method for Measurement of Surface Roughness of Abrasive Blast Cleaned Metal Surfaces Using a Portable Stylus Instrument.
  - A portable stylus roughness instrument utilizes a stylus that is drawn at a constant speed across a surface and records the up and down movements to determine the Rt, or the vertical distance between the highest and lowest valley within any given evaluation length. The instrument measures and records the vertical distance the stylus travels as it passes over the surface.

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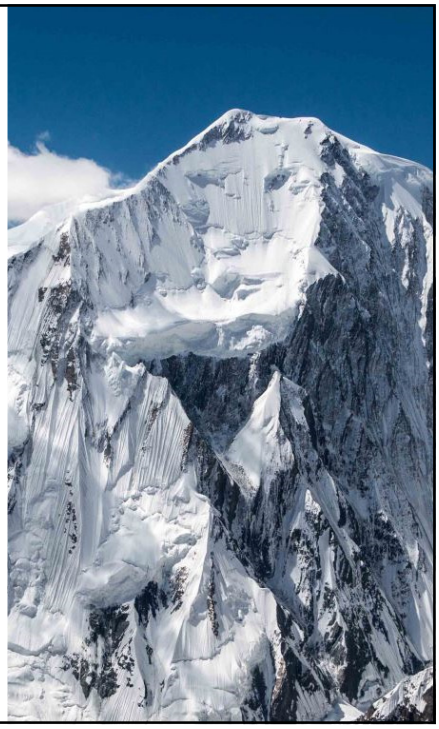
What are Important Factors in Surface Preparation Besides Cleanliness?

- Surface Profile
  - Peak Height
  - Peak Density
  - Peak Count
  - Angularity
  - Surface Area
  - Sharpness
  - Shape



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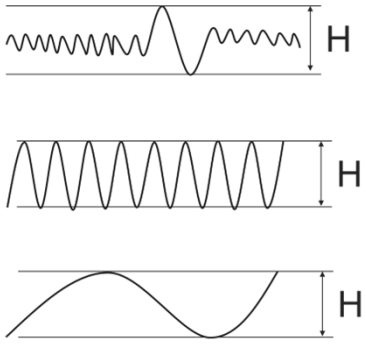
What are Important Factors in Surface Preparation Besides Cleanliness?

- Surface Profile
  - Peak Height
  - Peak Density or Peak Count
  - Limitations of height measurements using current instrumentation.



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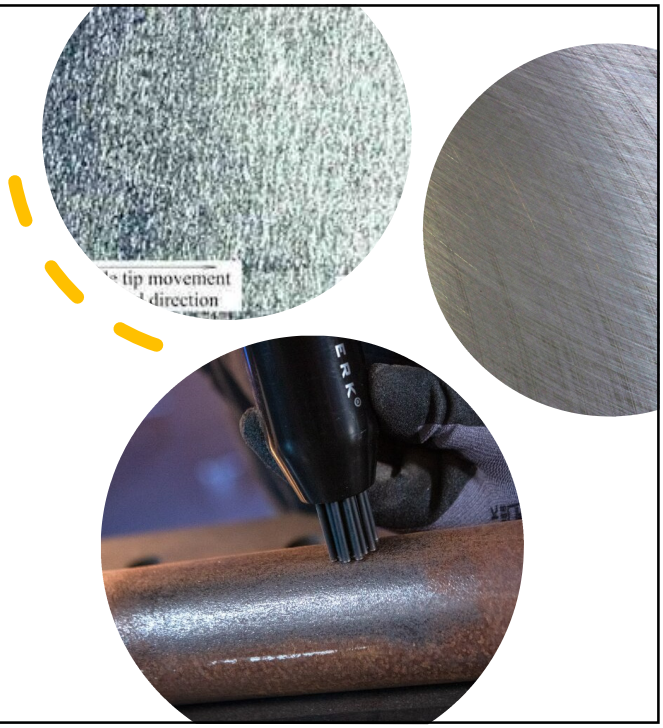
What's Important in Surface Preparation?

- Angularity
  - Angularity is often requested/discussed in relation to surface profile.
  - What does that mean.
  - Can we measure it.
  - What real affect does it have on coating performance.

- Definition: (Cambridge English Dictionary)
  - The quality of having angles rather than curves.
  - The quality of having or seeming to have sharp points.



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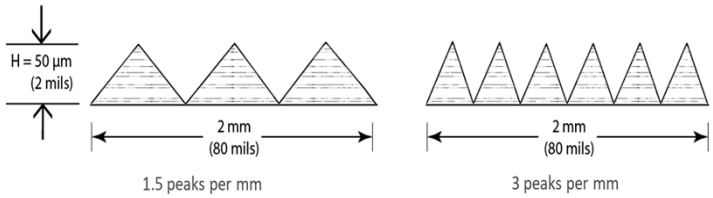
What's is Important in Surface Preparation?

- Surface Area
  - Surface preparation increases the surface area of the substrate, and this is generally accepted as a method of increasing the adhesion of the coating to the substrate.



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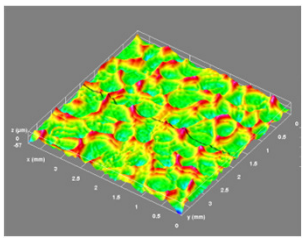
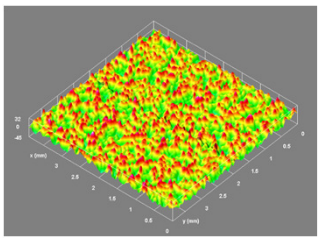
What is Important in Surface Preparation?

- Shape, Sharpness & Angularity of profile
  - The sharpness of the profile is sometimes discussed in association with the angularity of the profile.
  - Industry accepts that a "shot blasted surface" may display less adhesion than a "grit blasted surface" hence the requirements in some specifications for a blend of shot and grit when using a blasting machine (sometimes called a

Shot



Grit



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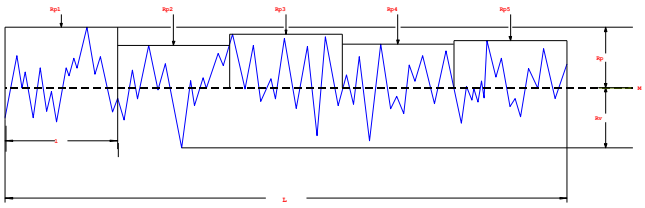
Surface Roughness Terminology

- Rp, Maximum Profile Peak Height
  - is the distance between the highest point of the profile and the mean line within the evaluation length.
- Rv, Maximum Profile Valley Depth
  - Is the distance between the deepest valley of the profile and the mean line within the evaluation length.

Rp, Rpm, Rv



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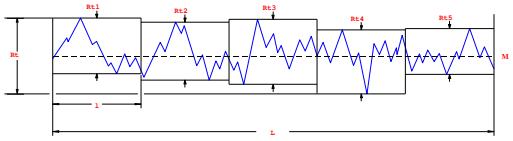
Surface Roughness Terminology

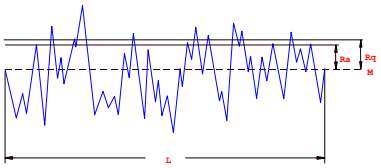
- Rz, Average Maximum Height of the Profile
  - Is the average of the successive values of Rti calculated over the evaluation length.

Rt, Rti, Rz, Rz(DIN), Rmax



- Ra, Roughness Average
  - Is the arithmetic average of the absolute values of the profile heights over the evaluation length.
- Rq, RMS Roughness
  - Is the root mean square average of the profile heights over the evaluation length.

Ra



Ra, Rq

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Historical Studies

- What is important?
- Historical studies have shown that Peak Height and Peak Count can affect coating performance
  - In 2005, a paper by Roper et. al. reported Peak Counts could be controlled and, like Peak Height, affected coating performance.
  - In 2015, a study by David Beamish (Defelsko) also observed a clear positive correlation between pull-off adhesion strength and Peak Count .
  - Draper, 2019: "…when the combined effects of profile height and peak spacing were evaluated together, the 2D combination was found to have a strong influence on coating performance."
  - Croll, 2020: "… the product of average peak height and peak count would be a useful expression … However, no single surface roughness parameter conveys all the ways in which a rough surface aids adhesion"
  - Reed, 2020: Found that re-blasting a below-spec-profile, high-peak-density sample into a within-spec-profile, low-peak-density sample worsened cathodic delamination (ASTM B117) performance

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A Different Way to Look at Surface Preparation

- We would like to recognize the following contributors
- Defelsko
- Graco
- M-Test
  - Additional information of profile is available under "Technical Information"
- A copy of the presentation will be available from:
- www.mtestco.com
- www.inspex360.com

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A Different Way to Look at in Surface Preparation

Thank you for your time.

Any Questions

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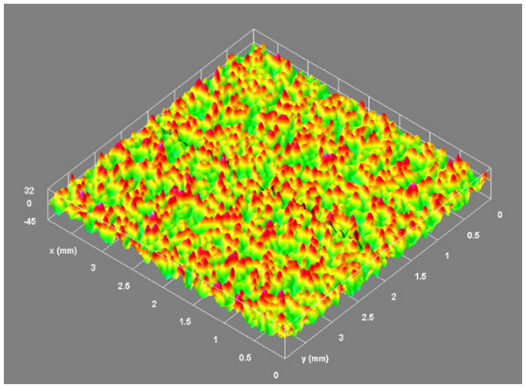
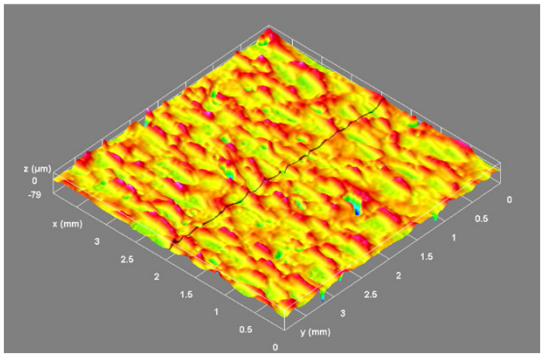
What's New in Surface Preparation?

- What is important?





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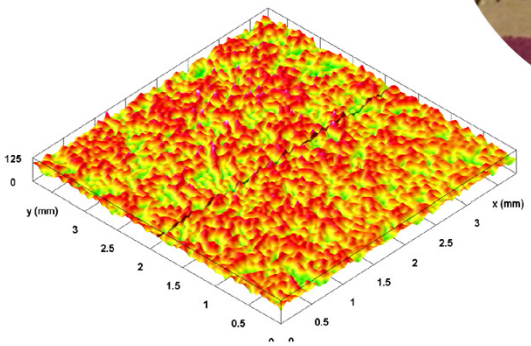
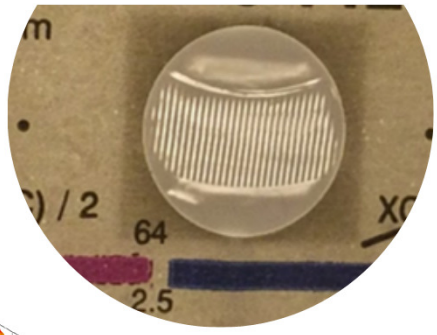
- What is important?





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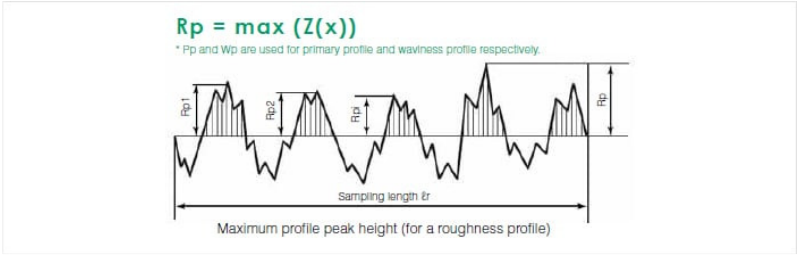

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