



Surface Preparation & Inspection For the Oil & Gas Pipeline Industry

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Unconventional Solutions

Experts in Composite Repair & Protective Coatings

Why is this important?

- What are green earth, environmentally friendly renewable energy, anti fossil fuel people like NRDC (www.nrdc.org) people saying about pipeline leaks or explosions?

Alarming analysis of fossil fuel pipeline incidents from 2010 to 2019:

- more than 5,500 total incidents
- almost 600 injuries
- more than 125 fatalities
- more than 800 fires
- almost 300 explosions
- more than \$4 billion in damages
- almost 30,000 people who had to be evacuated





Preparation Methods

A method should be chosen that...

- Will provide the required Standard of Preparation: **Read Tech Data Sheet & Applicable Company Standards**
- Will meet any of customer limitations
- Is appropriate for the area and the environment. (Dry Pipe, Wet Pipe)?
 - SPC 2888, 2831, 3888, 4888, 8888
 - Protal 7200, 7125, 7300, 7900
 - Scotchkote 323+ or 328
 - Petrolatum Tapes, Hot Applied Tape
 - Densotherm or Viscoelastic like Viscotaq

Preparation Quality

Regardless of the method of preparation, there are 2 fundamental qualities that are required of the substrate in order to ensure the success of the system to be applied

- 1. Cleanliness**

- 2. Profile**

Cleanliness



- Generally, for adhesion to the substrate to be successful, the substrate must be clean.
- Coatings are not normally very tolerant to CONTAMINATION. Contaminants may interfere with the chemical or physical interaction that is required between the coating and the substrate.
- ISO-8502-3:2017 Dust Assessment Test (pressure sensitive tape method)



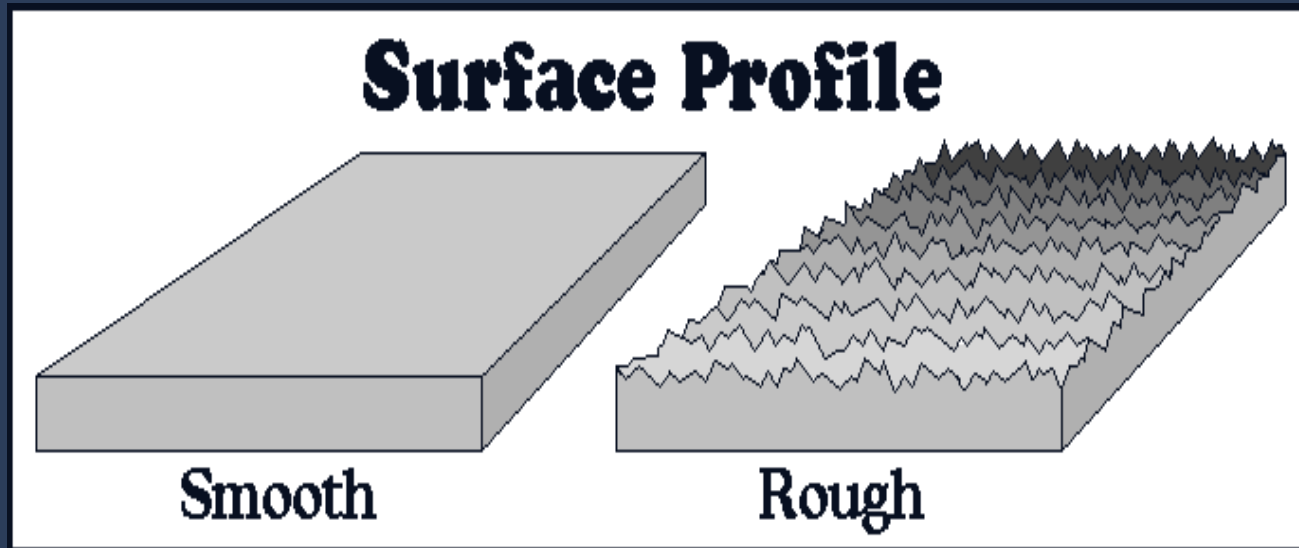


Profile

- Profile is (surface roughness) of the substrate?
- Most coatings require a PROFILE to gain a successful “KEY” to the surface.
- Example: Coatings for metals may require a substrate profile (2.5-4.5 mil or 0.0025-0.0045”) Reference MFG Specs.
- This profile is a physical requirement, which simply increases the AREA of CONTACT between the substrate surface and the coating.

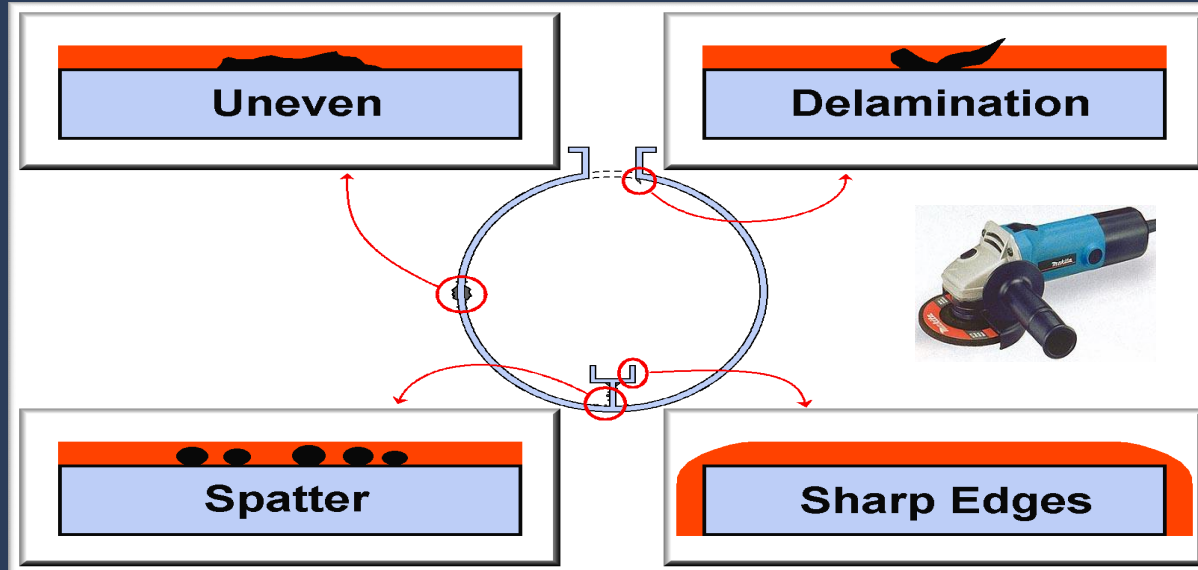
Profile

- This surface profile will also affect the amount of material used, as it must cover a larger surface area. As the profile (or roughness) of the surface increases, so will the material usage.



Steel Dressing

- Prior to the commencement of any abrasive blast cleaning it is necessary to remove any areas of steel which may protrude through the coating.



Abrasive Blasting

- Blast Media is fired at the surface at high speed. Many types of Blast Media are available: -
 - Coal Slag (Black Dimond or Black Beauty)*
 - Copper Slag*
 - Garnett *
 - Chilled Iron Grit
 - Aluminium Oxide
 - Steel Shot
 - Glass Beads
 - Plastic Media
 - Ceramic Beads
 - Sand
 - Quartz
 - Sponge Media
- The choice of media depends upon the material being prepared and the standard of preparation required.
- Make sure media is DRY! (blotter test)



Blast Profile (Roughness)

ASTM D 4417-03

Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel

NACE RP0287-2002

Standard Recommended Practice - Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape



Blast Profile (Roughness)

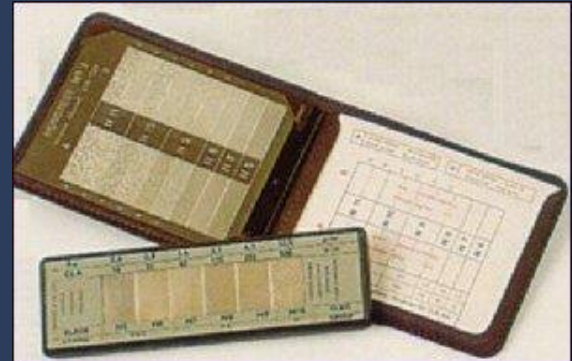
ISO 8503

Comparator type for judgement by eye and touch, microscope evaluation and pin gauge.



Rugotest No.3

Comparator type for judgement by eye and touch.



Surface Cleanliness Standards

	NACE	SSPC	ISO 8501-1
Solvent Cleaning		SSPC SP-1	
Hand Tool Cleaning		SSPC SP-2	St 2 or St 3
Power Tool Cleaning		SSPC SP-3	St 2 or St 3
Power Tool Cleaning to Bare Metal		SSPC SP-11	
Flame Cleaning		SSPC SP-4	F1
Pickling		SSPC SP-8	
White Metal	NACE No.1	SSPC SP-5	Sa 3
Near-White Metal	NACE No.2	SSPC SP-10	Sa 2 1/2
Commercial	NACE No.3	SSPC SP-6	Sa 2
Brush-Off	NACE No.4	SSPC SP-7	Sa 1
Water Blasting	NACE No.5	SSPC SP-12	

C Grade & D Grade Blasting



Detection of Surface Contamination

Soluble Salts

CHLOR*TEST "CSN"

(Chloride/Sulfate/Nitrate Ion Tests for Surfaces)

The CHLOR*TEST "CSN Salts" uses a unique patented extract solution, CHLOR*EXTRACT[®], to retrieve surface salt contamination. This special extract enhances retrieval rates, thereby increasing accuracy. The greater the retrieval rate, the more accurate the test results. If detected use **Chlor*Rid**

Surface sampling is simplified by use of the patented CHLOR*SLEEVE[®]. Sampling can be done overhead, vertically, horizontally or any angle with this device.



Climatic Control

- Freshly blasted steel can soon be spoilt by the onset of “flash rusting” or “spot rusting.” The time take for the blasted surface to be spoilt depends upon the atmospheric conditions and the steel temperature.
- For example: If the steel temperature is below the dew point for environmental conditions, water will condense on the freshly blasted surface, and flash rusting will be almost instantaneous.
- **When in doubt, preheat the pipe for liquid coatings**
- We can hold the blast (maintain the standard of the blast) by controlling atmospheric conditions with use of equipment such as **De-humidifiers**. With the right atmospheric conditions, the blast may be held to an acceptable standard for days. **Hold*Blast** is another option.

Blasted Surface

- Hands off
- Flash Rust



Manual Abrasive Processes

WIRE BRUSH: Removes loose rust and dirt. Manual or Mechanical wire brushing is a “Minimal” preparation method, (only removes loose debris and rust).

SANDING: Removes rust and scarifies softer surfaces. Hand held machines available such as Disc Abrasion (DA) machines. Very slow in scarifying hard metals.

ANGLE GRINDERS: Removes rust and coatings, and scarifies hard metals.

BRISTLE BLASTER: Removes corrosion and gives you an anchor profile. Bristle Blasting can be a NACE specified profiling process that uses a specially designed rotary bristle tool that can give you a visual cleanliness as achieved by grit blasting (near white metal or SSPC-SP11).



How to Operate Bristle Blaster

- [MONTI Bristle Blaster Video](#)





Environmental Conditions

- The product may not be tolerant to certain conditions. Any such limitations are listed on the product data sheet.
- Common restrictions that prohibit the application of the material are:
 - Relative humidity is above a certain level.
 - Air temperature is below a certain level.
 - Temperature of surface is less than 3°C (5°F) above the DEW POINT.
 - Substrate Moisture Content is above a certain level
 - **(When in doubt, preheat the pipe)!**

Dew Point

- This is the temperature at which water will condense on the surface. It depends on the relative humidity and the air temperature.
- Found by using a psychrometric chart, slide scale or computer program (online calculator or spreadsheet) that relates relative humidity and air temperature.

For example:

- If the Dew Point is found to be 15°C (59°F) and the Temperature of the surface to be painted is 14°C (57°F), then a layer of water droplets will have condensed on the surface.

Relative Humidity (RH%) & Dew Point



Digital Dewpoint Meter:

- Temperature
- Humidity
- Dewpoint



Wet Film Thickness (WFT)



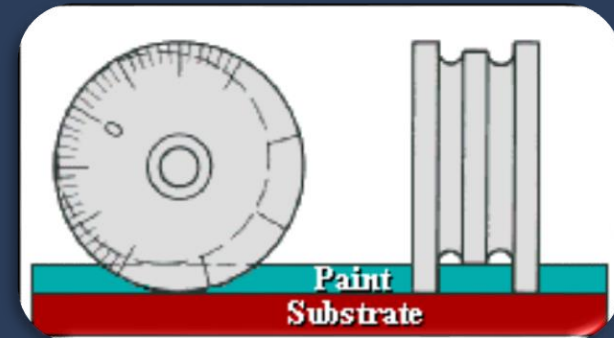
Comb Gauge:

Comb is dipped in the wet surface immediately after application to provide a reading



Eccentric Wheel:

Wheel is rolled in the wet surface immediately after application to provide a reading



Dry Film Thickness (DFT)

Eddy Current / Electronic Gauge:

These are the most accurate ($\pm 5\%$). Measurements are possible on ferrous and non-ferrous substrates.



Magnetic Gauge:

The most common is the “Banana gauge.” Typical accuracy is $\pm 10\%$. May only be used to measure non-ferrous coating over ferrous substrates



Material Conditions

- **Material Identity:**

Take a note of the identity of the materials, the Batch Numbers and the Dates Of Manufacture (D.O.M.) on the containers to be used of the work.

- **Material Temperature:**

Material temperature influences many application properties, the most prominent being Viscosity and Usable Life (for 2 Pack materials). Can be measured using a conventional thermometer or digital thermometer with an immersion probe.

Porosity Detection

- “Pinholes” are small craters in the film, normally created by air releasing from the surface of the film. Normally pinholes are problematic only in thin film coatings.
- “Holidays” are skipped or missed areas on the substrate that have not been coated.
- Both holidays and pinholes represent areas where the film is not continuous and therefore external elements can still make contact with the substrate.

Tinker & Rasor Holiday Detector (Spark Tester)



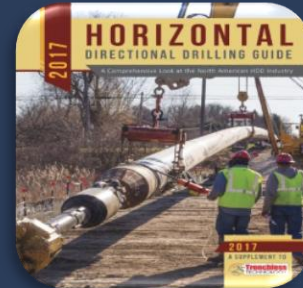
- If voltage used is too high, then the coating may be damaged by the test. Generally, 4 V/micron is used (125 V/mil or 100 V/mil).
- For example:

If dft is found to be 25 mils, and using 125 V/mil what should the voltage be?

3,125V (3.125kV)

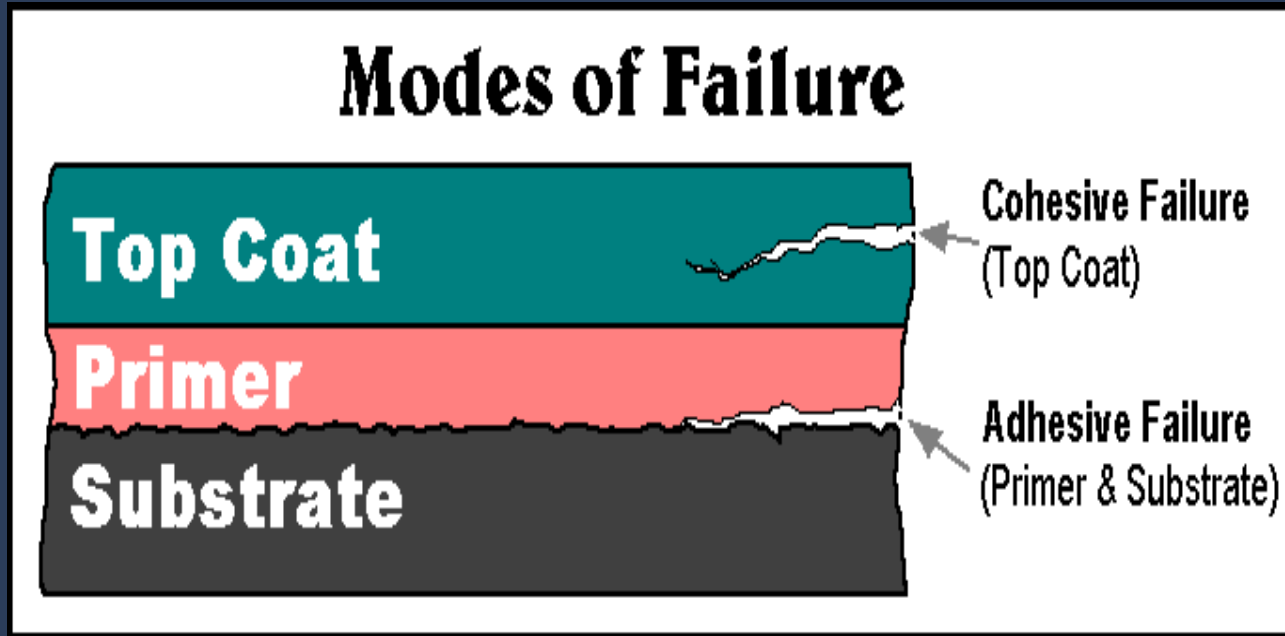
If the dft is 20 mils, and using 100 V/mil what should the test voltage be?

2000V (2kV)



Adhesion

- The “sticking power” of the coating to the substrate can be evaluated. All tests are destructive



X-Cut Test

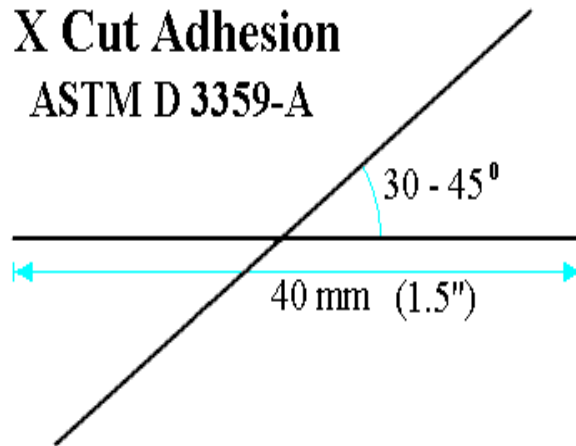
(ASTM D3359-A)

A sharp knife is used to make two cuts in the film down to the substrate to form a “X”. An adhesive tape is pressed onto the surface and then snatched off. Common indicative test for thin film systems.

Failure is classified as:

- 5A – No Removal
- 4A – Trace removal along incisions or intersection
- 3A – Jagged removal up to 1.6 mm from incision
- 2A – Jagged removal up to 3.2 mm from incision
- 1A – Removal of most of the X
- 0A – Removal beyond the area of the X

X Cut Adhesion ASTM D 3359-A



A low-angle, blue-tinted photograph of an industrial facility. Several large, vertical, cylindrical pipes or storage tanks dominate the foreground and middle ground. A complex network of metal scaffolding and support beams is visible, particularly around a central vertical structure. The sky is a pale, uniform blue. The overall image has a technical and industrial feel.

Selection of Pipeline Coatings



Petrolatum Tapes

- Proven technology for many applications
- Soil to Air to Transitions
- Bridge Crossing
- Below Grade
- Atmospheric Coatings

THIN LAYER OF PASTE PRIMER APPLIED TO THE SURFACE



PROFILING MASTIC FOR SHARP EDGES

- Protection of vault piping with petrolatum/wax tape system



PETROLATUM TAPE



- Sometimes sandblasting is awkward and environmentally questionable, particularly when the work is directly over a river or stream. Wax-Tapes do not require sandblasting.
- #2A Wax-Tape completely conforms to irregular surfaces, such as this gas wellhead, and is unaffected by the elements.
- The combination of Innercoat Hot-Applied Wax and Guard-Wrap is used to prevent corrosion of belowground metal structures.



EPOXY MID COAT – POLYURETHANE TOP COAT

- Organic and inorganic zinc primers have been popular for years
- Typically followed by an epoxy mid coat
- Polyurethane topcoat for UV stability



Petrolatum/Wax Tape



VISCOELASTIC OR AMORPHOUS A-POLAR POLYOLEFIN



- Adhesion – immediate and permeant adhesion
- Self-Healing – damage is minimized
- Minimal Surface Prep – good adhesion with SSPC-SP-2 or SP-3 surface prep
- Permeability for Moisture – coating impermeable to moisture
- Salt and Osmosis – impermeable to water and water vapor
- Application Failure – anyone can apply, no skill needed

Soil to Air Transition



Flanges



VISCOELASTIC OR AMORPHOUS A-POLAR POLYOLEFIN



Viscotaq Casing End Seal



Tapes

- Can be used by themselves but concerns with tenting and shielding
- Best used over primer, petrolatum or viscoelastic systems
- Most tapes are PE, PVC or Composite wraps for mechanical protection over softer systems
- Outer wraps can help with soil stress or freeze thaw on softer coatings
- Some Composite Wrap systems are excellent for Gas Riser Rehabilitation

ABRASION RESISTANT OVERCOAT WRAP/TAPE



RISER REHABILITATION SYSTEM



Liquid Epoxies



FBE and Epoxy



FBE and Epoxy



FBE FOLLOWED BY ACRYLIC COATING



FBE and Epoxy





COATING LIMITATIONS

Coating Limitations

- No such thing as perfect coating and that is why you have so many choices
- Remember you need to match the coating application to the right coating
- If you can abrasive blast using a 3 coat Zinc, Epoxy, Polyurethane makes sense
- If you can't blast consider one of three systems:
- Petrolatum primer and tape systems
- Viscoelastic tape systems
- Acrylic Coating Systems
- No one coating system works well in all environments so when unsure talk to a coating consultant, preferable someone that is independent and not going to direct you to just what their manufacture makes.

Coating Limitations

- Seek out a Subject Matter Expert to get the best results
- Different environments and regions require different coating systems
- Are you doing an ISO-8502-3:2017 Dust Assessment Test?
- All Coating need a SSPC-SP-1 Solvent Degreasing before commencing Hand-Tool, Power Tool, or Abrasive Blasting
- SSPC0SP-1 is the hidden specification

Questions & Answers



Summary

Correct surface preparation and quality control during an application is paramount to the success of any project.

- **Cleanliness:** ISO 8502-3 Assessment of dust on steel surface and Near White NACE #2 or SSPC-SP-10
- **Profile:** 2 ½ to 4 ½ mil profile to assure adhesion
- **Steel Dressing:** of rough edges before abrasive blasting
- **Salt Testing:** Chlor*rid CSN Field Test Kit
- **Environmental Conditions:** Climate Control/Relative Humidity
- **Bristle Blaster:** Preferred Surface Prep Tool for Smaller Areas





Thank You!

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