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Paper

WET ABRASIVE BLAST- WHEN WILL WE EVER GET A STANDARD?

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ABSTRACT

The Wet Abrasive Blast Cleaning Standards (WAB) covering the surface preparation and removal of coatings from metal substrates were in preparation with the Society of Protective Coatings (SSPC) in 1985. As of 2013, Wet Abrasive Blast Cleaning Standards have not been published by SSPC or National Association of Corrosion Engineers Int. (NACE) while the WaterJetting standards were published in 1994 and revised in 2002 and 2012. This paper will address the obstacles that have plagued this development.

1. INTRODUCTION

This paper will focus on Standards for coatings removal and repainting on industrial structures. In 1985, the author attended her first SSPC meeting to give an invited presentation on Water Jet Removal of Coatings by what was then very high pressure, 14 MPa (20,000 psi), and assumed the chairmanship of the coating cleaning and surface preparation standards for what is now called, Wet Abrasive Blast Cleaning (WAB). WAB is the use of abrasives and water together to strip off old coatings and corrosion from metallic substrates. In 1985, SSPC was "Steel Structures Painting Council"; the emphasis was on steel, not necessarily other metals, such as aluminum or bronze, or materials such as concrete. SSPC is now "Society of Protective Coatings" with an expanded focus to other materials than steel. This change in focus was one of the delay factors in taking 29 years to get from the first draft standard to a final ballot position.

Wet Abrasive Blast Cleaning uses abrasives to remove detrital material from substrates and produce a profile, or anchor pattern. The Standard language should parallel the dry Abrasive Blast cleaning standards (AB). In addition, rusting can occur while the wetted surface is drying, so cautionary language and a definition of "Flash Rusting" as found in the Waterjet Cleaning standards should be included in any Wet Abrasive Blast Cleaning standard.

1.1 Why work on Standards?

The coatings manufacturers, owners, operators, contractors, and inspectors all volunteer and cooperate to develop "STANDARD" language because this language is required by all contractual documents. These standards cover everything from environmental, recycling, methods, testing, processing, and quality control and are issued from U.S. societies such as SSPC, NACE, API, ASTM, and globally from International Organization for Standardization (ISO). Paint standards originate primarily from SSPC and NACE in the US and globally from ISO.

Visualize standards as a road map, which can be used at any time and any place, regardless of language or culture.

- Without 3rd party Standards, contracts can't be issued.
- With 3rd party Standards, Owners know what they are accepting.
- With 3rd party Standards, Contractors know what they are supplying.
- With 3rd party Standards, Coatings Manufacturers know what they are warranting.

All standards start with a draft, and then each line and paragraph are debated until a compromise or consensus is found. Most typically, no one party gets everything that they wish for in a standard. It takes years and thousands of man-hours to produce a third party standard. In the interim, many companies will author their own in-house policies and guidelines.

1.2 Typical Equipment Available in 1985

In 1985, the most common process to strip coatings or to create the situation so that the substrate was ready to be painted was dry abrasive blast cleaning. This is still true today. AB cleaning standards had already been issued. If water was used, the typical equipment in the field was a modification of dry abrasive blast systems to introduce water; or a modification of water blast

systems to introduce abrasive. (Figure 1 and 2) Pressurized water was primarily used to wash off dirt, bird feces, or loose material. Only a few contractors were using pressurized water to actually remove paint. There are many variations in equipment today, which is described in a draft technical report (not a standard) "REVISION OF SSPC/NACE JOINT TECHNICAL COMMITTEE REPORT SSPC-TR 2/NACE 6G198" entitled "Wet Abrasive Blast Cleaning." This document is available to the Task Group members and interested parties upon request.

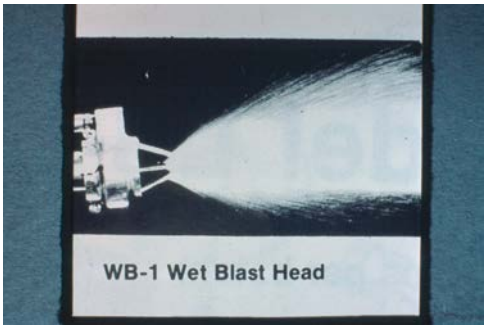

Figure 1 Example of External Wet Blast Head

Figure 2 Example of Internal Wet Blast Head

1.3 History of Development

Draft language for slurry blasting (WAB) was already available in 1985. However, there was only four people at the WAB or slurry blast standards meeting while the conventional dry abrasive standard was "standing room" only. There was simply no interest. I assumed chairmanship and bullied a few contractors and coatings manufacturers into the volunteer effort.

The coating industry proved to be remarkably resistant to change. In the US, it takes outside pressure to change existing practices. When silicosis became an issue, when environmental concerns grew, when the amount of waste generation became an issue, when salts remaining on older steel and performance became an issue, when economics showed that WJ or WAB could give a better job for less costs, interest in WJ and WAB picked up, and then stalled over and over, as contractors reverted back to AB and side-stepped change.

SSPC and NACE Int. had separate committees who were both working on the same painting documents. Between 1989 and 1994, the two organizations joined efforts and produced Joint Task Groups which led to a delay. The single standard draft was separated into two: wet abrasive blast (WAB) and water jetting without abrasives (WJ) with separate Joint Task Groups. Frenzel took on Water Jetting and was successful, with the assistance of many volunteers, to get the WJ standard published in 1995. The WAB document has been chaired by Frenzel, Jerry Woodson-now retired from Sherwin Williams, Peter Madonna-who worked for Muehlhan Group and is no longer in the paint industry, and finally back to Frenzel. We all failed and could not get consensus as we approached the development of language as a modification of the Dry Abrasive Blast Cleaning Standards (AB).

Photographs of Water Jet Cleaning, and Wet Abrasive Blast Cleaning were published by International Paint in 1994, and are available from SSPC. (REF 1) The WJ Standard came because International Paint, Jotun, Hempel, Sherwin Williams, and PPG all embraced the

concept of a clean, but freshly rusted surface. The language prohibiting any new rust on an abrasive prepared steel was unsurmountable for WAB.

2. OBSTACLES WITH THE STANDARDS- A NEW STANDARD BUT CAN EVERYTHING REMAIN THE SAME

It seemed painfully obvious in 1985 that the dry abrasive standard language could be modified slightly to include the effect of rusting when water was present. It took about 15 years and three chairman before the chairmen accepted that this modification just would not work. The Dry Abrasive Blast Cleaning language was too specific. To this day, the industry continues to delude itself with the idea that the contractors might use water and abrasive because of dust or salt issues, but the users want the production rates, the width of the cleaning pattern, and the appearance to be exactly the same as dry abrasive blast cleaning. The current Draft under ballot was began in 2005; it took until 2013 to get it to ballot. Table 1 compares AB and WJ.

Dry (AB) or Wet Abrasive (WAB) Cleaning and Pressurized Water (WJ) Cleaning are different!

Table 1 Comparison of AB and WJ Cleaning Method

Dry or Wet Abrasive (AB)	WaterJet (WJ)- water only
New and Repair	Repair
Makes new Profile	Exposes profile under paint or corrosion
Erases from the top	Shears at Interface
Looks Uniform	Exposes all Problems
Cleans top, leave crevices alone	Gets into crevices, can leave top material
NO RUST-BACK Allowed (DRY AB)	FLASH RUST allowed (WJ)
FLASH RUST allowed (WAB)	

Steel surfaces prepared by WAB cleaning might develop flash rust within minutes while the water is drying after the cleaning is completed. This amount of rusting is simply too large a hurdle for decades of contractors who demand NO re-rusting occur when abrasives are used.

2.1 Obstacle- How Many Documents? How Much to Include?

NACE and SSPC have established five (5) degrees of cleaning for AB; ISO 8501-1 has established four (4) Degrees of Surface Cleanliness. NACE and SSPC issue separate standard documents and use the language as the primary reference with photos being secondary. NACE and SSPC uses percentages for cleaning. ISO started with primary photos and a little language as supplemental. ISO issues one document with all four degrees of cleaning and combines visual photos as integral to the document. ISO uses descriptive terms such as ‘free from poorly adhering material, free from most material, only slight stains remain, free from “material” and uniform metallic color.’ (REF 2)

The practicality is that US contractors could not seem to understand that FOUR distinct degrees of cleaning might be located in the ONE standard that had been issued for WaterJet Cleaning. (REF 3)

European contractors and persons familiar with ISO documents accept and use a standard document which can include several degrees of cleaning. It took from 1985 to 2005 to establish that **separate** WAB documents must be written and that those documents would contain all of the language, not references to previously established AB standards.

2.2 Obstacle: What to call the Degrees of Cleaning

NACE and SSPC AB standards use "white metal", "near-white metal", "commercial," "industrial", and "Brush Off" for degrees of cleaning. NACE and SSPC WJ standards, and ISO standards use "bare Metal," "Very-Thorough cleaning," "Thorough Cleaning,', and "Light Cleaning" to designate degrees of cleaning.

Table 2 Names and Numbering for Abrasive and Water Jetting Cleaning Standards

Cleaning Degree (abrasive) NACE, SSPC	Cleaning Degree (water alone) ISO, NACE	NACE abrasive	NACE SSPC WJ	SSPC Abrasive Blast	ISO Abrasive 8501-1	ISO Water 8501-4
White metal	Bare metal	1	WJ-1	SP-5	Sa 3	
Near-White	Very Thorough	2	WJ-2	SP-10	Sa 2 ½	Wa 2 1/2
Commercial	Thorough	3	WJ-3	SP-6	Sa 2	Wa 2
Industrial	Thorough	8	WJ-3	SP-14		
Brush Off	Light	4	WJ-4	SP-7	Sa 1	Wa 1

2.3 Obstacle: RUST- No re-rusting, Rust-Back, and Flash Rust

The rusting of steel after the initial cleaning is the greatest and most contentious of the obstacles. This issue single-handedly kept the WAB standard from proceeding to completion. Water and oxygen are present.

The 1982 version of SSPC Good Painting Practice volume 1 and 2 defined **Flash Rusting** as "Rusting that occurs on metal within minutes after exposure to moisture." Flash Rusting is further discussed in the "Water Blast Cleaning" chapter. "Steel cleaned by water blast or water pressure flashes rust upon drying unless an inhibitor is in the spray solution or applied immediately after blasting." The term "hydroblast" is also used. The "Air Abrasive Blast Cleaning" chapter and the four abrasive specifications: White Metal Blast Cleaning, Near-White Blast Cleaning; Commercial Blast Cleaning, and Brush-Off Blast Cleaning refer to "Rust Back" in paint commentary, section 8 Rust Back. (REF 4)

Commentary: Section 8 Rust Back (1982) contains the following:

…."Rust back occurs when freshly exposed bare steel is exposed to conditions of high humidity, moisture, or a corrosive atmosphere. The time intervals between blast cleaning and rust back will vary greatly (from minutes to weeks) from one environmental to another. ……. Under normal mild atmospheric conditions it is best to coat a blast cleaned surface within 24 hours after blast cleaning. Under no circumstances should the steel be permitted to rust back before painting, regardless of the time elapsed." ……

The stage was set to allow NO new rusting on abrasive cleaned surfaces.

The following are the current SSPC glossary definitions and clarify the presence or absence of water:

Flash Rust is (1) An oxidation product that forms as a **wetted** carbon steel substrate dries (2) Appearance of rust spots on the surface of newly-applied water-borne film **during** the drying phase.

Flash Rust is the rust that occurs from the time the waterjet (WJ) or wet abrasive blast (WAB) cleaning process starts to the time the water used for the cleaning process dries. Flash rust often looks like a rust bloom.

With the exception of stainless steel surfaces, any steel surface may show flash rust, depending on environmental conditions, after cleaning by water. Flash rust quickly changes the appearance of the cleaned surface and may be reduced or eliminated by physical or chemical methods. The color of the flash rust may vary depending on the age and composition of the steel and the time-of-wetness of the substrate prior to drying. With time, the flash rust changes from a yellow-brown, well adherent, light rust to a red-brown, loosely adherent, heavy rust.

Rust-Back (rerusting) is rusting that occurs when freshly exposed, ***DRY***, bare steel is exposed to conditions of high humidity, moisture, or a corrosive atmosphere. It is the term used when steel cleaned by dry abrasive blasting, power tools, or wet abrasive blasting begins to rust after the steel surface has completely dried.

Rust-Back is used in wet or dry abrasive blast standards (SSPC SP-5, SP-10, SP-6, SP-7). Rust-Back occurs on surfaces that appear to be dry.

Rust Bloom is discoloration indicating the beginning of rusting.

Rust Bloom is new rust. The appearance is a somewhat uniform rust spread evenly over a large section of the surface. Rust Bloom is a generic description. The observer doesn't know if the rust bloom originates from a wet condition- flash rust- or a dry condition- rust-back.

All of the figures in this paper and Frenzel 2011 WJTA paper are examples of **Rust Bloom**. (REF 5)

Examples of **Rust Back** under dry conditions of controlled atmospheric humidity and temperature are found in Frenzel. (REF 5) This **Rust Back** is typically caused by salts on the surface that was not removed by the dry abrasive blast cleaning and occurs rather quickly. Rust Back under dry conditions is typically caused by the presence of salts which carries the current between the anode and cathode combined with atmospheric water molecules on a surface which appears to be dry. Contractors should not paint over salts if they know that salts are present,.

These are examples of standard **Flash Rust** from International Paint (SSPC) photos for wet abrasive blast cleaning where the re-rusting occurs as the water is drying.

Figure 4 Examples of Light, Moderate, and Heavy Flash Rust from REF 1

The following figures emphasize that the extent of flash rusting is dependent upon the "Time of Wetness" when the contractor is WAB or WJ cleaning. Flash rusting can be minimized by reducing the time of wetness, typically by vacuum, squeegee, or compressed air drying. The longer the water sits on the surface, the more the flash rust.

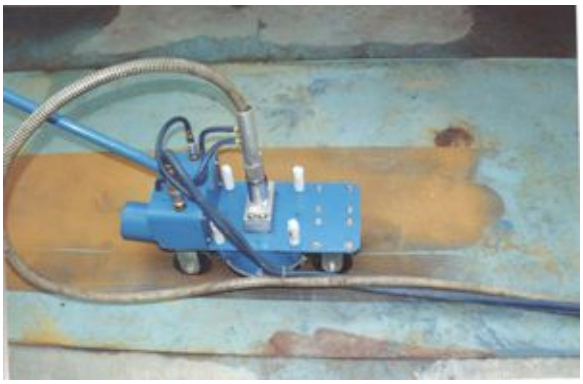

Figure 5 Moderate to Heavy Flash Rust on horizontal surface as a result of a drying time of minutes.

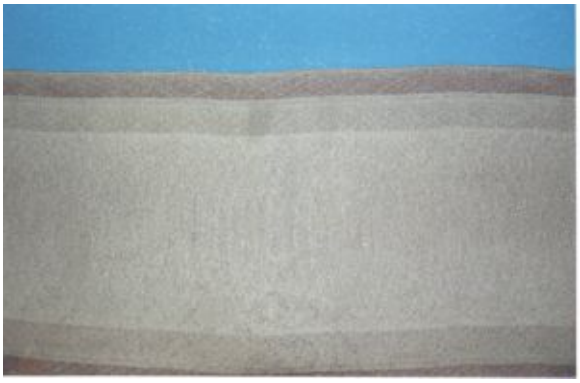

Figure 6 None to Light Flash Rust on vertical surface under same conditions as Figure 5. The water steamed off the surface and dried in a matter of seconds.

John Kelly, pointed out that "There is more than one kind of rust" in Marine Log. (REF 6) "General atmospheric rusting or rusting in immersed conditions is contaminated with chemicals from the environment to which the metal has been exposed, such as chlorides or sulfates. In contrast, flash rust formed after preparing surfaces by water jetting using potable water consists of pure iron oxide, which, noted Kelly, is actually a constituent of some coatings. At low to medium levels, flash rust is suitable for overcoating with many coating system, since it is tightly

adherent and won't react with the metal substrate or the coating applied over it. This fact needs to be appreciated when inspecting surface prepared by water jetting."

Restated, it is the **CAUSE** of the re-rusting that is the problem and prohibits the acceptance of any new rust on a dry abrasive blast cleaned surface. It is not the clean iron oxide itself.

2.4 Obstacle: Presence of Wetted Abrasive

As part of the process, the contractor must remove the wetted abrasive as soon as feasible within the operating conditions. Wetted abrasive that stays on the surface will trap moisture and slow the drying process. To minimize flash rust, the wetted abrasive should be removed; this is often accomplished by a low pressure washing of the surface. Dried dust that remains on the surface acts as a pin-point source for rusting with an oxygen concentration differential cell.

3. CURRENT STATUS

Outside forces are pushing the finalization of the WAB standard. There is multiple equipment available with many different options, from almost all abrasive with a little water to 38 MPa (40,000 psi) UHP water jet cleaning injected with a little abrasive. Environmental, health and safety issues, and economics are driving this change. The industry has finally realized that paint manufacturers will accept light to moderate Flash Rust for a typical atmospheric application. The performance quality are excellent. It is past time for WAB standards to be adopted.

NACE and SSPC are currently balloting PROPOSED NACE STANDARD PRACTICE/SSPC SURFACE PREPARATION STANDARD "SSPC-SP 10 (WAB)/NACE WAB-2 Near-White Metal Wet Abrasive Blast Cleaning" as the template language for the other four WAB standards.

This standard defines the Near-White Metal Wet Abrasive Blast Cleaning (NACE WAB-2/SSPC-SP 10 (WAB) degree of visible surface cleanliness of uncoated or coated steel surfaces achieved by the use of wet abrasive blast cleaning. The requirements include the end condition of the surface as determined by visual inspection, and materials and procedures used to achieve and verify the end condition. This standard is intended for use by coating or lining specifiers, applicators, inspectors, or others whose responsibility is to define a standard degree of surface cleanliness for carbon steel surfaces to be achieved by wet abrasive blast cleaning.

WAB cleaning is a process using a mixture of water and abrasive that can produce various levels of surface cleanliness and surface profile (roughness) similar to those obtained with dry abrasive blast (AB) cleaning.

The proposed five degrees cleaning defined by NACE and SSPC for WAB are:

Table 3 Names and Numbers for WAB Standard Practices

Degree of Surface Cleanliness	Designation
White Metal WAB	SSPC-SP 5 (WAB) /NACE WAB-1
Near-White Metal WAB	SSPC-SP 10 (WAB)/NACE WAB-2
Commercial WAB	SSPC-SP 6 (WAB)/NACE WAB-3
Industrial WAB	SSPC-SP 14 (WAB)/NACE WAB-4
Brush-Off WAB	SSPC-SP 7 (WAB)/NACE WAB-5

Note that these numbers are yet a different sequence from current descriptors and numbers. The author strongly suggests that future users of the documents used the text descriptors to avoid confusion.

The current template language is analogous to the AB standards. This is the ***definition*** of Near-White which is under ballot;

Near-White Metal WAB Surface: A near-white metal WAB surface, when viewed without magnification, shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, corrosion products, and other foreign matter. Random staining shall be limited to no more than 5 percent of each unit area of surface (approximately 5,800 mm^2 [9.0 in^2]; i.e., a square 76 mm x 76 mm [3.0 in x 3.0 in]), and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coating.

The proposed language contains a section on Flash Rust that is not found in the Dry Abrasive Blast Cleaning Standards.

Analogous to the AB Cleaning Standards, the standard contains sections: Procedures before WAB cleaning; WAB Cleaning Methods, WAB Cleaning Materials, Procedures Following Wet Abrasive Blast Cleaning, Immediately Before Coating, and additional non-mandatory commentary and Apendices.

4. CONCLUSIONS

The acceptance of Flash Rust with wet abrasive blast cleaning as the water is drying, combined with the absolute refusal to accept Rust Back under dry abrasive blast cleaning operation, led to this lengthy standard development.

The development and publication of the Water Jet Cleaning Standards had to be completed before the Wet Abrasive Blast Standards task groups could build consensus language.

Unless other unforeseen obstacles arise, NACE and SSPC will have Wet Abrasive Blast Cleaning Standards published in late 2013- early 2014, a mere 29 years from the first draft.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

1. International Paint “Slurryblasting Standards,” 1994; SSPC-VIS 5/NACE VIS 9 (latest revision), “Guide and Reference Photographs for Steel Surfaces Cleaned by Wet Abrasive Blast Cleaning” (Pittsburgh, PA: SSPC and Houston, TX: NACE).

2. L. M. Frenzel, “A comparison of ISO and NACE-SSPC Development of Surface Preparation Standards Including Dry Blast and High Pressure Water Jet Cleaning Methods”, **Fixing Pipeline Problems**, October, 2012, Berlin, Germany, Sponsored by Tiratsoo Technical and Clarion Technical Conferences

3. Joint Surface Preparation Standard NACE NO. 5/SSPC-SP 12 “Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating” NACE International, Houston, TX, Item. NO. 21076 or SSPC, Pittsburgh PA., 1995. This has been replaced with 4 separate standards, published in 2012. i.e. Joint Surface Preparation Standard, “Waterjet Cleaning of Metals SSPC-SP WJ-2/NACE WJ-2 – Very Thorough Cleaning”

4. SSPC *Steel Structures Painting Manual*, Pittsburgh, PA, 1982, 2nd Edition, Volume 1 “Good Painting Practice”, pages 52, 64, 81: Volume 2 “Systems and Specifications”. Pages 18, 39,41, 43, 47

5. L.M. Frenzel, 2011 WJTA-IMCA Conference and Expo. “What’s Happening In Surface Preparation Standards For Paint”. Paper D1

6. J. Kelly, “There's More than One Kind Of Rust,” Marine Log, May, 1996, p. 18