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MARINE INDUSTRY STANDARDS  
WELDING  
INDUSTRIAL ENGINEERING  
EDUCATION AND TRAINING

January 1998  
NSRP 0501

# **THE NATIONAL SHIPBUILDING RESEARCH PROGRAM**

## **Develop Visual Standards for Hydroblasting of Steel**

U.S. DEPARTMENT OF THE NAVY  
CARDEROCK DIVISION,  
NAVAL SURFACE WARFARE CENTER

in cooperation with  
Peterson Builders, Inc.

# Report Documentation Page

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National Shipbuilding Research Project  
# 3-96-1

Develop Visual Standards for Hydroblasting of Steel  
Final Report  
December 28, 1997

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- A. Task Chart
- B. Letters of agreement from SSPC
- C. Letter of agreement from NACE
- D. Matrix
- E. List of Initial, February, 1997, Photographs
- F. List of Final July, 1997, Photographs
- G. Note Aside: Observations which confirm other papers, visual sets, field comments

### Primary Objective

The primary objective is to produce a set of preliminary reference photographs which will meet the written requirements of the existing cleaning documents of the Steel Structures Painting Council and/or National Association of Corrosion Engineers, Inc. (SSPC/NACE). These reference photographs will be presented to an ad hoc committee for selection. As the consensus process for a final technical standard may take a long time, an agreement from a standards agency such as SSPC or NACE will be sought.

### **Phase 1**

Task 1. Standards Organization Participation.

Letters from SSPC and NACE dated February, 1996, indicate that both organizations are willing to take the preliminary reference photographs which result from the NSRP project and place them into the consensus building process for final issuance as a "Visual Standard." This was confirmed with a conversation with Dr. Simon Boocock on October 8, 1996. This was confirmed with correspondence from Dr. Boocock on October 11, 1996 (Attachment B,C ).

### **Phase 2 and Phase 3**

Task 1 & 2 Review of the Photographs

Task 1. Delivery to Standards Agency:

In June and July, 1997, each member of the Technical Advisory Committee reviewed and accepted the final photographs.

The final oral report was presented at the July, 1997, meeting of the NSRP SP-3 in Portland, Maine. After the July, 1997, meeting of the NSRP SP-3 panel in Maine, Dr. Brenda Holmes, NAVSEA O3M, and Dr. Simon Boocock, SSPC, again reviewed the photos, which had been accepted by the TAC for NSRP #3-96-1 Waterjet visual project. Dr. Holmes and Dr. Boocock approved of the photographs as fulfilling the objective.

Subsequently, original slides sets from February, 1997, and the July, 1997, reference photographs were delivered to SSPC on August 8, 1997 for a total of 96 slides. Around the first of September, 1997, Dr.

Frenzel spoke to Russell Davison, SSPC staff member who is responsible for their production of photographs and visual standards, about whether SSPC wanted an electronic format. Russell said that SSPC preferred to use the slides and make their own electronic files.

The NSRP draft photos have been presented to the standards committees at NACE at Fall Committee Week in Chicago and to the SSPC at their November meeting in San Diego. The consensus process for a visual photograph set is now in progress as a joint NACE/SSPC task with Dr. Lydia Frenzel, chairman.

#### **Phase 1**

Task 2. Technical Advisory Committee

As of October 16, 1996, The NSRP SP-3 Advisory Committee members are:

Ben Fultz- Bechtel

Steve Cogswell- Atlantic Marine

Richard Dupuy- UHP Projects

John Kelly- International Coatings

Dr. Simon K. Boocock- SSPC.

John Meacham- Peterson Builders, Project Manager

It is anticipated that the Water Jet Visual Joint Task Group of SSPC/NACE will continue their work when it is time to build a consensus "Visual Standard." This group currently includes the following people who already participate in NSRP SP-3 meetings on a regular basis:

Ben Fultz- Bechtel

John Kelly- International (Courtaulds) Coatings

Max Winkeler- Sigma Coatings

John Tanner- Ameron (Devoe) Coatings

Lydia Frenzel- Chair

These individuals, or representative of their companies were involved in the preview discussion and the final revised photographs.

#### **Phase 1**

Task 3. Matrix Development:

The Matrix was discussed at the NSRP- SP 3 meeting in October, 1996 with revision at the November, 1996, SSPC meeting . At the SSPC meeting, the revision group included: John Meacham PBI, Ben Fultz- Chair of the SP-3 TAC, Dr. Simon Boocock- SSPC Director of Research, and Dr. Lydia Frenzel. Each TAC member was contacted subsequently for input.

The matrix is attachment D.

Conditions C and D are "new construction" surface conditions for rust grade C and D.

Conditions E, F, and G are maintenance surface conditions. Conditions E, F, and G represent surfaces having aged coating originally applied over blast-cleaned steel.

Condition E is a previously painted steel surface, paint mostly intact, some primer may show.

Condition F is a previously painted steel surface, paint applied over blast cleaned steel, paint is mostly intact, but more deteriorated than E.

Condition G is paint thoroughly weathered, blistered or stained; the paint may have been applied over marginally prepared steel, or the steel may have deteriorated where the paint is not present.

It is recognized that some of the painted steel surfaces may have not been previously blasted.

The coating systems will be selected to represent a typical primer, zinc-rich paint, and a multiple coat paint system.

#### **Phase 1**

Task 4. Representative steel substrates:

Plates from SSPC arrived on December 24<sup>th</sup>, 1996, and were screened for inclusion.

Todd Pacific Shipyard sent panels for Rust Grade D, damaged primer (Paint Grade F), and severely damaged multi-coat system (Paint Grade G) directly to Flow International.

## **Phase 1**

Task 5. Clean panels and photograph

Site Selection:

Flow International Corporation, 13500 64<sup>th</sup> Ave South, Kent , WA 98032 offered their laboratory and equipment for the cleaning and photography site. Contact Person: Rick Schmid-Marketing; Tom Cross-Vice-President, Ron Tarrant- Chairman.

Appreciation and Recognition are extended to:

Sean Vaughan- Demonstration Lab Manager

Chris Downing- Demonstration

Travis Gohl- Demonstration

Rick Schmid- Water Jetting Manager.

This project received strong support from the Waterjetting Community. Other companies which offered sites or cleaning were:

Aqua-Dyne Inc., George Rankin, President, Houston, TX

Butterworth Jetting Systems, Mike Ginn, President, Houston, TX

NLB Corporation, Forrest Shook, President, Wixom, MI

WOMA Corporation, Frank Scharwat, Seattle, WA

Cavi-Tech Inc, Roland Lever, President, Kennasaw, GA

UHP Projects, Richard Dupuy, President, Norfolk, VA

Cleaning and photography took place at Flow International during January and April, 1997. The use of the equipment and facilities is a major donation in kind which was fundamental in the completion of the project. Most project demonstrations last a few hours. Flow released their equipment for five days for this project.

Lee Boutelle, Government Sales Manager, Cortec Inc. donated Vapor Phase Corrosion Inhibitors to protect the steel panels after blasting during the shipping period and while the final photographs were being taken.

Cleaning Conditions:

The photographs were produced to be equipment independent. They represent the final performance criteria of a process and are not tied to a specific methodology with respect to pressure or volume.

The Hornet five-orifice nozzle had openings of 0.009 inch and was rotated at 1800 rpm . The pressure was 40,000 psi at a rate of 2 gallons per minute.

No inhibitors were used. The City of Kent has two water sources with conductance at 73 and 128 micro Siemans on the days of cleaning. The general water supply to Flow is a blend of these sources which vary from 73 to a high of 200 micro Siemans. It is filtered before entry into the UHP WJ pump, but otherwise is not treated. The panels were dried with compressed air and flash rusting did not occur. During the course of the project, we did prepare one panel where two areas were cleaned to show that the side area has started to form a light bronzing appearance. The light flash rust is apparent where there are two areas for side-by-side comparison.

Preliminary Photographic Considerations:

During December, 1996, the visual photographs of SSPC VIS-1, VIS-3, ISO, German, International Coatings, Cavi-Tech, and Hempels were critically examined to determine if the lighting should be from the side to enhance shadows, profiles, and protrusions or evenly distributed to enhance color differences. The angle of lighting plays a critical role in what the observer sees. After looking at results from side lighting, Dr. Frenzel decided that an even lighting sequence should be used as this emphasizes the coloration and cleanliness. Side lighting emphasizes the profile and protuberances on the panels.

Lighting and film were matched so that the color is true. Color standards and a gray scale were placed on each roll of exposed film.

Photographs:

Multiple panels were selected for each column on the matrix. Approximately 300 photos were taken in January, 1997. The set-up for the photos had been determined in December so that a color standards was placed on each roll. The master is a transparency. When the transparency is printed as a slide the final print is one: one scale with the original panel within 10%. The original area of the panel is 4 inches by six inches. The original is a 35-mm slide. When the slide is printed in a 4 x 6 format, the reproduction is a one to one correspondence.

The standoff distance was initially set at 10 inches with a transverse rate of 80 feet per minute. The standoff and transverse rate was varied to obtain the defined surfaces. The definitions for waterjetting are performance definitions, not process standards.

The panels supplied by SSPC were very educational. Exposed coatings, which seemed intact, frequently had heavy black rust under the paint. When the coating was removed, the pattern was not one of a uniform abrasive blasted surface, but rather a corrosion pattern with very dark steel. Type C rust grade, which SSPC had prepared to be uniform over the whole surface.

Attachment G contains additional observations and comments.

Photograph Review:

February, 1997

Approximately 100 photographs were reviewed at the February, 1997, NSRP SP-3 meeting.

List of Persons Present at NSRP SP-3 Selection Meeting in January, 1997.

NSRP indicates the NSRP TAC for this project; TGI is the Task Group of SSPC and NACE who will develop the standard.

Lydia Frenzel	Advisory Council	209-267-0992	NSRP, TGI
John Meacham	Peterson Builders Inc.	414-743-5577 x 281	NSRP
Simon K. Boocock	SSPC Dir. Of Res.	412-281-2331	NSRP, SSPC
John Kelly	International Paints	713-684-1221	NSRP, TGI
Ben Fultz	Bechtel	713-235-3620	NSRP, TGI
Steve Cogswell	Atlantic Marine Inc.	904-251-1714	NSRP
Richard Dupuy	UHP Projects	757-928-1890	NSRP
Gordon Kuljian	Ocean City Research	610-344-7002	NSRP WJ project
Mike Winter	Sigma Coatings	504-347-4321	
	(representing Max Winkeler on TGI even though substitutes are not official)		
John Tanner	Ameron	410-788-0431	TGI

Final Review July, 1997

From April to June, 1997, we produced photographic prints of the supplemental photographs which were requested by the TAC in February. The final photographs were distributed for comments. Each of the series had been printed according to the standard four-color process. Photographs were then produced.

The lists of delivered slides are attachment E and F.



Item	% of Project	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
3-90-1 Performance Period							<b>Performance Period</b>										
<b>Phase 1</b>																	
Task 1 Enlist Cooperation of Standards Agency																	
Deliverable 1- Selection of Standards Agency				▲	Done, Oct, 1996												
Task 2 Determine the make up of Ad Hoc Committee																	
Deliverable 2- Report on Names of Committee				▲	Done, Oct, 1996												
Task 3- Develop Matrix																	
Deliverable 3- Report on Matrix						▲	Done, Oct, 1996										
Deliverable 4- Progress report on 1,2,3	10%					▲											
Task 4 Obtain Representative Samples																	
Deliverable 5- Obtain Plates and Panels								▲	Done, Dec, 1996								
Deliverable 6- Selection of sites					▲	Done, Oct, 1996											
Task 5 Clean Panels and Photograph																	
Deliverable 7 Clean Panel, Initial Photographs preparation								▲	Done, Jan, 1997								
Deliverable 8- Completed agreement with Standards Agency									▲	Done, Oct, 1996							
Deliverable 9 Presentation of Milestone Report	53%							▲	Done, Feb, 1997								
<b>PHASE 2 Submission of Photo and Selection</b>																	
Task 1 Present Photographs to Committee																	
Deliverable 10 Presentation of Photographs to Committee										▲							
Task 2- Supplement Photographs																	
Deliverable 11- Development of Supplement Photographs														▲	Done June 1997		
Deliverable 12- Produce electronic format																	
Deliverable 13- Presentation of Milestone Report														▲	Done June 1997		
<b>PHASE 3 Submit Photographs to Standards Agency</b>																	
Task 1 Submit Photographs	27%																
Deliverable 14- Presentation of Photographs to Standards Agency																▲	Done 8/8/97
Deliverable 15- Final Report (Draft)															▲	Done Dec 98	
Deliverable 16- Submit final Report	10%															▲	
	100%																



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**TO:** Mr. John Meacham, Program Manager  
NSRP Project 3-96-1

cc: Dr. Lydia Frenzel

**FROM:** Simon K. Boocock, Director of Research

**DATE:** February 28, 1996

**SUBJECT:** **Cooperation with NSRP on Visual Reference  
Photographs**

---

SSPC would be happy to cooperate with NSRP on production of visual reference photographs for high pressure water jetting.

SSPC would be interested in publishing the NSRP visual reference photographs as SSPC standards. SSPC and NACE International are currently working on development of visual standards for wet blast cleaning.

SSPC is willing to make an in-kind contribution of staff time to develop the standard.

A handwritten signature in black ink that reads 'Simon K. Boocock'. The signature is written in a cursive style with a long, sweeping underline.

NSRP # 3-96-1  
Final Report  
PBI P.O. Number 13784

Attachment B

P.2/2

FEB 28 '96 09:47AM SSPC CONF&TRAIN 412 281 9993



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October 11, 1996

Ms. Lydia Frenzel  
Advisory Council  
P. O. Box 850  
Sutter Creek, CA 95685

Dear Lydia:

The SSPC would indeed be willing to cooperate in the NSRP 3-96-1 project to develop "Visual Standards for Water Jetting." We can convene a committee, perhaps at the upcoming National Conference in Charlotte. Since we have published other visual standards, it is only natural that SSPC publish visual standards for water jetting. The visual standards would naturally complement our written standard SSPC-SP 12, Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating, published jointly with NACE as NACE No. 5.

The SSPC has developed a series of matrices to identify what specific photographs would be desirable to have in a visual standard. These matrices include large areas (e.g. ship hull), photographs already prepared by International Paint, and new photographs of small samples that need to be taken. Copies of the matrices are enclosed with this letter.

The list of members of the TGI Committee is also attached. The addition of NSRP members would be welcome.

A partial list of painted 4 x 6" panels currently on hand at SSPC is attached also. The attached list identifies the coating systems and DFT. These panels were either unexposed or exposed in a prohesion/UV-condensation cycle. There are scribes but very little rust on the exposed panels. We also have between 100 and 200 panels, 4 x 12 x 1/4", that were coated with plastic flame coat. Some were coated over old paint and others were applied over a blast cleaned surface. Another source of weathered panels would be our Neville Island site. We could probably gather together 50 to 100 similar PACE panels that have weathered for over 15 years. Some may still be buried in the dirt after the January 1996 flood. Rust ratings on these panels would range from 5 to 8. If the panels do not have to have similar paint systems, we can provide you with well over a hundred 4 x 12" panels that have weathered to ratings less than 6.

We also have a supply of unpainted panels. There are over 100 Rust Grade B panels with partially rusted millscale. These are 4 x 6 x 5/8" or 5 x 6 x 3/8".

I hope that this information is sufficient for your needs. If you want further details, we will be glad to provide them to you.

Sincerely,

Simon K. Boocock  
Director of Research



## TECHNICAL PRACTICES COMMITTEE

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73357.243@compuserve.com

February 27, 1996

Lydia Frenzel  
P.O. Box 850  
Sutter Creek, CA 95685

Dear Lydia:

In follow up to our conversation earlier today and your fax of February 16, I am writing to confirm NACE's interest in the NSRP project to develop photographic standards for water jetting.

Although I have not yet contacted appropriate Technical Practices Committee officers to initiate formal approval, I am confident the TPC would support this work. At a minimum, NACE would be willing to act as a third-party publisher of the final project document.

If you choose to pursue joint publication with SSPC and NACE, NACE would be willing to consider a joint agreement.

Please let us know how to proceed. We look forward to working with you on this project.

Sincerely,

Helena Buist  
Director—Technical Activities

P.O. Box 218340 · Houston, Texas 77218-8340  
Executive Offices: 1440 South Creek Drive · Houston, Texas 77084-4908 · (713) 492-0535 · Telex No. 792310 NACE HOU  
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NSRP #3-96-1  
Final Report  
PBI P.O. Number 13784

Attachment C

11

Matrix #5

1/1/97

**Proposed Photos for  
Water Jet Visual Standards  
( NO Abrasive)**

	Initial Condition				
	Intact Coating (Standard E)	Coating (Standard F)	Deteriorated (Standard G)	Rust Grade D	Rust Grade C
WJ-1	x	x	x	x	x
WJ-2	x	x	x	x	x
WJ-3	x	x	x	x	x
WJ-4	x	x	x	x	x

The cleaned panels will not include three grades of flash rusting

Intact mill scale may be present under some of the coatings.

Conditions C and D are “new construction” surface conditions for rust grade C and D.

Conditions E, F, and G are maintenance surface conditions.

Condition E is a previously painted steel surface, paint mostly intact, some primer may show.

Condition F is a previously painted steel surface, paint applied over blast cleaned steel, paint is mostly intact, but more deteriorated than E.

Condition G is paint thoroughly weathered, blistered or stained; the paint may have been applied over marginally prepared steel, or the steel may have deteriorated where the paint is not present.

The coating systems will be selected to represent a typical primer, zinc-rich paint, and a multiple coat paint system.

## Attachment E

February, 1997, Initial Selection of Photo Sets with comments on correction and work to be completed. Delivered to SSPC as 46 transparencies and one additional color standard. The black and white standard is included with the final slide set.

### Rust Grade C

\*C-2 6 photos Steel supplied by Todd Pacific Shipyard.

Cleans to gray color. easily seen areas where corrosion pattern is heavier. Spot of weld stain on steel is visible.

C1-2, C2-2, C3-2, C4-2, C5-2, C 6-2

----

### Rust Grade D

\*D-2 6 photos Steel supplied by Todd Pacific.

Rust pops off and leave black stain. Weld Splatter is visible at upper right.

Work to be done- remove orange tinge present in some of WJ-1 and WJ-2.

D1A-2, D2A-2, D3A-2, D4A-2, D5A-2, D6A-2,

-----

### E- Single Coat Primer- intact

E-0 6 photos Red Primer, weathered, no rust- supplied by SSPC

Work to be done: make islands of paint more diffuse on {E4}; insert partial sequence between {E4} and {E5}; print {E5} with and without stain.

E1A-0, E2A-0, E3A-0, E4A-0, E5A-0, E6A-0

E-2 7 photos Green primer, weathered, no rust- Supplied by SSPC

Work to be done- decrease contract of green and steel; move from reddish tinge to blue gray steel; supply intermediate between WJ-2 {E5} and partial removal of paint {E4}

E1A-2, E2A-2, E3A-2, E4A-2, E5A-2, E6A-2

-----

### F deteriorated paint single coat.

F-0 6 photos- Alternate Set Gray zinc supplied by Todd.

Panel cleans up nicely, but difficult to see the difference between steel and zinc. Work to be done: Supply photo w/o any paint (WJ-1)

F1A-0, F2A-0, F3A-0, F4A-0, F5A-0, F6A-0

F-4 4 photos Gray zinc supplied by SSPC

This came off very rapidly. The initial steel had a dark stain which was removed gradually.

Work to be done: supply intermediate between WJ-4 and WJ-1

F1A-4, F2A-4, F3A-4, F5A-4

-----

### G Multi-coat System -deteriorated

\*G-2 12 photos Supplied by Todd Pacific.

yellow, blue, yellow, white multi-layer paint. This series shows the gradual removal of the coating layers, the black staining under the coating, pits, and removal of black oxide.

Use this series to show partial removal of WJ-4

Work to be done: Remove some of smaller paint island in intermediates; provide WJ-3

G1A-2, G6A-2, G9A-2, G11A-2, G12A-2, G14A-2, G15A-2, G16A-2, G17A-2, G18A-2

## Attachment F

Final Selection- Delivered to SSPC as 47 transparencies plus two additional color and black and white standards.

Print in a 4 inches by 6 inches format to obtain a one:one correspondence with the original area which is 4 inches by six inches.

Rust Grade C Series- 5 pictures The spot near the center is a thermal effect. There was a weld on the back side. This change in steel due to heat stress is very evident in cleaning by waterjetting.

C- original (C1c-2)

C- brush off WJ-4 (C2c-2)

C- cleaner WJ-3 (C3c-2) (C4c-2 is alternate view)

C-- cleaner WJ-2 (C5c-2)

C remove background stain WJ-1 (C6c-2)

Rust Grade D-2 Series. 6 pictures The TAC requested that the "yellow" be taken out. This is now done. For my personal taste, this is to the "blue" side. The degree of yellow to blue should be reserved for the agency standards review and discussions with the printer.

D- original (D1c-2)

D- brush off WJ-4 (D2c-2)

D- WJ-3 (D3c-2)

D- alternate Wj-3 cleaner leaving (D4c-2)

D- WJ-2 (D5c-2)

D WJ-1 (D6c-2) Only light stain is present.

Paint Grade E-2 Series- Green Primer. 9 photographs . Panel TTK2 Lighten background. Produce intermediate coverage photos. The initial comment was that the surface was brown until the paint was removed and then the final photo was "steel" gray. In April, we determined that this is a true representation of the condition under the paint. Multiple intermediate cleaning photographs are included. The steel under the paint is without pitting (Type A).

E- original (E1c-2)

E- Brush off WJ-4 (E2c-2)

E- partial removal (E3c-2) not on photograph as it is more than 30 percent coverage.

E- partial removal (E4c-2)

E- partial removal WJ-3 (E5c-2)

E- partial removal (E6c-2)

E-partial removal (E7c-2)

E- WJ-2 (E8c-2)

E - WJ-1 (E9c-2)

Paint Grade E-0 Series- Red Primer (Alternate E). 7 photographs Panel TLD 1. The initial coverage of 30% and 5% were okay. The committee wanted to reduce the islands of paint and make the background lighter for the intermediate cleaning. We determined that the contrast from dark to light was real in the April session because corrosion had occurred under the paint. We prepared the background as if the paint was over an inactive surface.

The larger specks of paint are very typical of cleaning by water jetting. The waterjetting method cleans around an adherent area. It does not produce the eroded effect as does abrasive blasting.

E- original (E1c-0)

E- brush off (E2c-0)

E- partial removal (E3c-0)

E-partial removal (E4c-0)

E- partial removal WJ-3 (E5c-0) and different exposure.

E- partial removal Wj-2 (E6c-0)

E- complete removal WJ-1 (E7c-0)

Paint Grade F-4. Zinc Silicate Primer. 6 photographs. Provide intermediate coverage.

F original (F1c-4)

F- brush off WJ-4 (F2c-4)

F- partial removal WJ-3 ( F3c-4)

f- partial removal WJ-3 (F4c-4)

F- partial removal WJ-2 (F5c-4)

F- complete removal WJ-1 (F6c-4)

Paint Grade F-0 Alternate Zinc Silicate Primer. 6 photographs Panel MQF. Provide a shot of "clean" for WJ-1. In April, we determined that the paint is removed, but a definite pattern is seen on the surface. The WJ-1 pattern does not appear as pronounced as paint removed from steel with dark corrosion patterns, but it does not clean to a uniform appearance.

F- original (F1c-0)

F- brush off WJ-4 (F2c-0)

F- partial removal WJ-3 (F3c-0)

F- partial removal WJ-3 (F4c-0)

F-mostly removed WJ-2 (F5c-0)

F- all removed WJ-1 (F6c-0) faint stain.

Paint Grade G-2 Multi-Coat Degraded. 8 photographs. Remove some of the smaller islands of paint from the intermediate. We did this, but with great reluctance. Some of the small islands of paint were tightly adherent. They remained on all the photographs. Shadows along the sharp edges of the paint islands result from the lighting, not from lifting edges of paint.

G- original (G1c-2)

G- partial removal WJ-4 (G2c-2)

G-partial removal (G3c-2)

G-partial removal WJ-3 (G4c-2)

G-partial removal (G5c-2)

G- partial removal WJ-2 (G6c-2)

G- just a few specks left WJ-2 (G7c-2)

G- complete removal WJ-1 (G8c-2)



## Attachment G

Observations which confirmed other papers, visual sets, field comments.

After the February, 1997, NSRP meeting, Dr. Frenzel spoke with Ray Weaver of SSPC. The panels, which exhibited black rust under the coating, had initially been rusted at an ocean location. Some had been abrasive blasted and coated; some had been cleaned with a woven disc. This observation of black corrosion products under coatings reinforces the NSRP results of Dr. Soltz regarding the impact of residual salts on the surface. It also verifies the results of the German STG # 2222 photographic results with WJ at 10,000 psi.

On April 22-24, 1997, Dr. Frenzel went to Flow International and photographed more sequences to assure that there would be an acceptable series for each condition and to satisfy some of the comments made by the TAC during the February NSRP SP-3 meeting..

These series include:

B Steel- Series B-2

C Steel Series C-3

D Steel Series D-3

Red Primer Series E- 6, 7, and 8; Plates TKM2 and TJF1

Green Primer Series E-4 and 5 Plate TJC

Gray Silicate Series F-5 Plate MZM. This is a pickled surface or power wire brush.

Green Silicate Series F-6 Plate MVZ. Original surface is prepared with citric acid.

Todd supplies Gray Silicate Series F-7

Green Silicate Series F- 8 and 9 Plate MUA

Multi-coat Series G- 3 Todd Plate

None of these photographs are being submitted as a deliverable as it is felt that the original plates satisfied the conditions for the SSPC/NACE definitions.

When the primer is removed from steel, which has underlying black corrosion stains, first the paint is removed to leave a dark substrate. Then the black stain is removed to reveal the "gray" surface. This is the case in many of the original series where the TAC felt that the background was too dark.

This was seen in the first series of photographs Paint Grade E Primer and E Primer alternate and is a true representation. The comment to "lighten" the background alters the true condition to a perceived reality.

C Steel. In April, we cleaned steel which originated from the rusting of hot rolled steel which originally had intact mill scale. The rusting had progressed to the C stage. These were the back side of plates supplied by SSPC. When the panel was cleaned, the pattern of light and dark followed the original rusting pattern. The mill scale was off, but it did not look uniform. The appearance is light with darker carbon stains. This is very different from the appearance produced by abrasive blast removal of Rust Grade C.

The surfaces under Grade C Rust only look uniform if they were first blasted prior to rusting.

For the F series- zinc silicate. We observed that the paint came off easily from each of the plates. However, there is a gray stain left on the surface. When a photograph is made, it looks like paint is still on the surface when in reality it is a discoloration or a pattern of dull and light reflective areas. There is no actual paint left on the surface. This may be the source of complaints in the field that the "water jetting does not take off zinc silicates easily." When the stain is black, it is easily distinguished from the paint and steel surface. The zinc paint leaves a gray stain.

G Series. We confirmed that small islands, which were tightly adherent, resulted from removal of the paint by expansion from existing cracks, pits, and crevices. We removed the small islands of paint on the original series as requested by the TAC. It is not true that small flecks are loosely bound.

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