



NACE
INTERNATIONAL

SSPC-VIS 4

Guide and Reference Photographs for
Steel Surfaces Prepared by
WATERJETTING

NACE VIS 7

SSPC Publication 01-05

NACE Item No. 22016

ISBN 1-889060-56-9

**620.11223
S678**

SSPC-VIS 4 NACE VIS 7

Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting

Guide Text copyright © 2001 by
SSPC: The Society for Protective Coatings
and NACE International

Photographs from International Hydroblasting
Standards reproduced with the permission of
International Paint, Inc.

© Courtaulds Coatings (Holdings) Ltd.

Photographs (Condition G) from
Hempel Protection
"Photo Reference Water Jetting"
reproduced with the permission of
HEMPEL Copenhagen
© J.C. Hempel's Skibsfarve-Fabrik A/S

All Rights Reserved

*This book or any part thereof must not be
reproduced in any form without the written
permission of the publishers*

SSPC Publication No. 01-05
NACE Item No. 22016
ISBN No. 1-889060-56-9

SSPC: The Society for Protective Coatings

40 24th Street, 6th Floor
Pittsburgh, PA 15222-4656
Phone 412-281-2331 • Fax 412-281-9992
books@sspc.org
<http://www.sspc.org>

NACE International
1440 South Creek Drive
Houston, TX 77084-4906
Phone 281-228-6200 • Fax 281-228-6300
tcc@mail.nace.org
<http://www.nace.org>



CONTENTS

Guide to Reference Photographs for Steel Surfaces Prepared by Waterjetting

Appendix

Reference Photographs for Steel Surfaces Prepared by Waterjetting

Initial Conditions of Unpainted Steel

Degree of Cleaning Over Condition C

Degree of Cleaning Over Condition D

Initial Conditions of Previously Painted Steel

Degree of Cleaning Over Condition E

Degree of Cleaning Over Condition F

Degree of Cleaning Over Condition G

Degree of Cleaning Over Condition H

Examples of Effect of Flash Rusting

Initial Condition C

Cleaned Condition C WJ -2

Flash Rusting over Condition C WJ-2

Initial Condition C

Cleaned Condition C WJ-3

Flash Rusting over Condition C WJ-3

Initial Condition D

Cleaned Condition D WJ-2

Flash Rusting over Condition D WJ-2

Initial Condition D

Cleaned Condition D WJ-3

Flash Rusting over Condition D WJ-3

BR PETROBRAS
570



570-0015467



PETRÓLEO BRASILEIRO S.A.
PETROBRAS

ENGENHARIA / SL / DTL

DOCUMENTAÇÃO TÉCNICA E LEGAL

Nº Petrosin

349726

Código de Barras

570-0015467

Nº Peripuc

Data

07.08.2008

Guide to SSPC-VIS 4/NACE VIS 7

Reference Photographs for Steel Surfaces Prepared by Waterjetting Disclaimer

SSPC and NACE International issue this Guide and Reference Photographs in conformance with the best current technology regarding the specific subject. This Guide represents a consensus of those individual members who have reviewed this document, its scope, and provisions. This Guide is intended to aid the manufacturer, the consumer, and the general public. Its acceptance does not in any respect preclude anyone, whether he has adopted this Guide or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not in conformance with this Guide. Nothing contained in this Guide is to be construed as granting any right, by implication or otherwise, to manufacture, sell, or use in connection with any method, apparatus, or product covered by Letters Patent, or as indemnifying or protecting anyone against liability for infringement of Letters Patent. This Guide represents minimum requirements and should in no way be interpreted as a restriction on the use of better products or materials. Neither is this Guide intended to apply in all cases relating to the subject. Unpredictable circumstances may negate the usefulness of this Guide in specific instances. Neither NACE nor SSPC assumes responsibility for the interpretation or use of this Guide by other parties.

Users of this Guide are responsible for reviewing appropriate health, safety, and regulatory documents and for determining their applicability in relation to this Guide prior to its use. This Guide may not necessarily address all safety problems and hazards associated with the use of materials, operations and/or equipment detailed or referred to within this document. Users of this Guide are also responsible for establishing appropriate health, safety, and environmental protection practices, in consultation with appropriate regulatory authorities if necessary, to achieve compliance with any existing applicable regulatory requirements prior to the use of this Guide.

CAUTIONARY NOTICE: This Guide is subject to periodic review and may be revised or withdrawn at any time without prior notice. This Guide must be reaffirmed, revised, or reviewed no later than five years from the date of initial publication. The user is cautioned to obtain the latest edition. For information on this and other joint SSPC/NACE publication, contact either organization. The SSPC Publications Dept. may be contacted at 40 24th Street, Pittsburgh, PA 15222-4656 (telephone +1 412-281-2331). The NACE International Membership Services Department may be contacted at 1440 South Creek Drive, Houston, Texas 77084-4906 (telephone +1 281-228-6200).



1. SCOPE

1.1 This Guide describes the use of Reference Photographs depicting the appearance of unpainted rusted carbon steel and painted carbon steel, with or without rust, prior to and after cleaning by waterjetting (WJ). The Reference Photographs are intended to supplement the written standard SSPC-SP 12/NACE No. 5.¹ Pictures and descriptions of flash rusting are included for illustrative purposes. The written standards are the primary means to determine conformance with cleaning requirements. The photographs should not be used as a substitute for these standards.

2. DESCRIPTION

2.1 The Reference Photographs consist of a series of 1:1 (actual size) color photographs that represent various conditions of unpainted and painted carbon steel surfaces prior to and after waterjet cleaning. (See Section A.1.)

2.1.1 The user of this Guide should designate the degree of cleaning as WJ-1 (Clean to Bare Substrate), WJ-2 (Very Thorough Cleaning), WJ-3 (Thorough Cleaning), or WJ-4 (Light Cleaning) of SSPC-SP 12/NACE No 5. (See Section 4.2.)

2.1.2 This Guide can be used to clarify the acceptable level of flash rusting allowed prior to the application of protective coatings. The coating manufacturer should be contacted to verify that the coating material selected is suitable for application over the maximum allowable degree of flash rusting that has been specified. (See Sections A.3, A.4, A.5, A.6, and A.7.)

2.1.3 The user of this Guide should designate the maximum degree of flash rust permissible as None (the condition immediately after cleaning), Light (L), Moderate (M), or Heavy (H) Flash Rust. (See Section 4.4.)

2.1.4 The two series of flash rust photographs are illustrative of steel substrates cleaned by wet methods specified in WJ-1, WJ-2, WJ-3, or WJ-4 of SSPC-SP 12/NACE No. 5, not just for the conditions illustrated herein. Illustrative photos are included for Conditions C and D but not for Conditions A and B.

3. REFERENCED PUBLICATIONS

3.1 The publications referenced in this Guide are listed in Section 3.3 and are necessary for proper use of this Guide.

3.2 The latest issue, revision, or amendment of the referenced publications in effect on the date of invitation to bid shall govern unless otherwise specified.

3.3 SSPC AND NACE INTERNATIONAL REFERENCED PUBLICATIONS:

SSPC-SP 12/NACE No. 5 Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Waterjetting Prior to Recoating

SSPC-SP 1² Solvent Cleaning

4. CONDITIONS DEPICTED

4.1 INITIAL CONDITIONS: The Reference Photographs illustrate five of the seven initial conditions⁽¹⁾ before surface preparation as follows (see Section A.1):

Condition A (not illustrated): Steel surface completely covered with adherent mill scale; little or no rust visible.

Condition B (not illustrated): Steel surface covered with both mill scale and rust.

Condition C: Steel surface completely covered with rust; little or no pitting visible. The area includes an example of a discoloration caused by heat. (Rust Grade C)

Condition D: Steel surface completely covered with rust; pitting visible. The area includes an example of foreign matter. (Rust Grade D)

Condition E: Previously painted steel surface; light-colored paint applied over blast-cleaned surface; paint mostly intact.

Condition F: Previously painted steel surface; zinc-rich paint applied over blast-cleaned steel; paint mostly intact.

Condition G: Painting system applied over mill scale bearing steel; system thoroughly weathered, thoroughly blistered, or thoroughly stained.

Condition H: Degraded painting system applied over steel; system thoroughly weathered, thoroughly blistered, or thoroughly stained.

4.1.1 Other Conditions: When waterjetting is used to remove paint and other contaminants from mill scale bearing steel (Conditions A, B, and G), the mill scale is not usually removed. In that case, the appearance of the cleaned steel would be very similar to Initial Condition A or B.

⁽¹⁾ Initial Conditions A, B, C and D are sometimes referred to as Rust Grades A, B, C, and D, respectively.

4.2 END CONDITION: The various degrees of cleaning, with no flash rust, are described in SSPC-SP 12/NACE No. 5 (see Section A.2) as:

WJ-1	Clean to Bare Substrate
WJ-2	Very Thorough or Substantial Cleaning
WJ-3	Thorough Cleaning
WJ-4	Light Cleaning

4.3 Steel surfaces show variations in texture, shade, color, tone, pitting, flaking, and mill scale, which should be considered when making comparisons with the reference photographs. Acceptable variations in appearance that do not affect surface cleanliness include variations caused by type of steel, original surface condition, thickness of the steel, weld metal, mill fabrication marks, heat treating, heat affected zones, and differences caused by the initial abrasive blast cleaning technique or by the cleaning pattern. (See Sections A.1 and A.8.)

4.4 FLASH RUST: The Reference Photographs also illustrate three degrees of flash rust. Flash rust or rust bloom is a light oxidation of the steel, which occurs as waterjet-cleaned steel dries off. It quickly changes the appearance. 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. (See Sections A.3, A.4, and A.5.)

Four series of photographs depict previously painted steel cleaned by waterjetting to produce WJ-1, WJ-2, WJ-3, and WJ-4 of SSPC-SP 12/NACE No. 5. Four initial conditions for paint applied over blast cleaned steel (Conditions E, F, G, and H, defined in Section 4.1) are depicted at each level of visible cleanliness.

4.4.1 No Flash Rust: A surface which, when viewed without magnification, exhibits no visible flash rust.

4.4.2 Light Flash Rust (L): A surface which, when viewed without magnification, exhibits small quantities of a yellow/brown rust layer through which the steel substrate may be observed. The rust or discoloration may be evenly distributed or present in patches, but it is tightly adherent and not easily removed by light wiping with a cloth.

4.4.3 Moderate Flash Rust (M): A surface which, when viewed without magnification, exhibits a layer of yellow/brown rust that obscures the original steel surface. The rust layer may be evenly distributed or present in patches, but it is reasonably well adherent and lightly marks a cloth that is lightly wiped over the surface.

4.4.4 Heavy Flash Rust (H): A surface which, when viewed without magnification, exhibits a layer of heavy red/brown rust that hides the initial surface condition completely. The rust may be evenly distributed or present in patches, but

the rust is loosely adherent, easily comes off, and leaves significant marks on a cloth that is lightly wiped over the surface. (See Sections A.5 and A.6.)

4.5 APPEARANCE: It is generally true that, when the surface is still damp or wet, it appears darker, and defects and variations in shading are magnified. As the surface is drying, streaks form which are not necessarily depicted in these small unit size photographs, but which may be clearly seen on larger areas. Whether or not streaks are acceptable should be addressed between the contracting parties. An example of streaking can be seen in C WJ-3 L and C WJ-2 M.

5. Procedures

5.1 DETERMINE INITIAL CONDITION: If the steel has not been previously painted, proceed to Paragraph 5.1.1. If it has been painted, proceed to Paragraph 5.1.2. Steel to be cleaned may contain more than one of the initial conditions. (See Sections A.1 and A.8.)

5.1.1 Unpainted Steel: Select the photograph of initial condition (C or D) that most closely represents the appearance of the unpainted steel to be cleaned.

5.1.2 Painted Steel: Select the photograph of the initial condition (E, F, G, or H) that most closely represents the appearance of the previously painted steel to be cleaned.

5.2 SELECT PHOTOGRAPH: Refer to Table 1 to select which reference photograph depicts the finished surface corresponding to the condition determined from Section 5.1 and the degree of cleaning specified in the procurement document.

5.3 DEGREE OF CLEANING: Immediately after waterjetting, but before the surface has flash rusted, compare the prepared surface with the photograph selected in Paragraph 5.2. The degree of cleaning should conform to WJ-1, WJ-2, WJ-3, or WJ-4 of SSPC-SP 12/NACE No. 5 as specified in the procurement document. (See Sections A.6, A.7, A.9, and A.10.)

5.4 DEGREE OF FLASH RUST: Prior to painting, compare the flash-rusted surface with the flash rust photographs. The list of flash rust photographs is given in Table 2. For non-pitted surfaces, use the C flash rust photographs for either painted or unpainted initial conditions. For pitted surfaces, use the D flash rust photographs for either painted or unpainted initial conditions. For example, if WJ-2 is specified and the steel is pitted, use D WJ-2 L, D WJ-2 M, or D WJ-2 H to evaluate the degree of flash rust that has occurred.

5.5 APPEARANCE IMMEDIATELY PRIOR TO COATING: The degree of flash rust specified shall be in accordance with Section 4.4. If no flash rust is acceptable, the surface



shall conform to Section 4.4.1 immediately prior to coating. The coating manufacturer may be contacted to verify that the coating material selected is suitable for application over the degree of flash rust that has occurred. (See Sections A.1, A.3, A.4, A.5, A.6 and A.7.)

5.6 ADDITIONAL CONSIDERATIONS: The Reference Photographs shall be used only in conjunction with the written surface preparation specifications. The photographs are based upon appearance only, are for illustrative purposes, and do not address other factors necessary for compliance with the written specification. (See Sections A.9 and A.10.)

Condition C contains an example of heat-affected discoloration. Condition D contains an example of foreign matter. Condition G is a degraded system of gray primer, red intermediate, and cream topcoat. The photos G WJ-3 and G WJ-2 show islands of black, tightly adherent mill scale that were uncovered during the cleaning. In G WJ-1, the mill scale has been removed but the discoloration pattern remains.

Condition G illustrates a non-brittle paint system that can be feathered. Condition H shows a brittle paint system in which the paint edges remain sharp.

REFERENCES

- ¹ SSPC-SP 12/NACE No. 5 (latest revision), "Surface Preparation of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating" (Pittsburgh, PA: SSPC and Houston, TX: NACE).
- ² SSPC-SP 1 (latest revision), "Solvent Cleaning" (Pittsburgh, PA: SSPC).
- ³ SSPC Painting Manual, Volume 2, *Systems and Specifications* (latest revision), "Surface Preparation Commentary" (Pittsburgh, PA: SSPC).

APPENDIX A: EXPLANATORY NOTES

A.1 INITIAL CONDITIONS: Initial Conditions C and D are "new construction" surface conditions, and are defined in the SSPC Surface Preparation Commentary, where they are referred to as "Rust Grades."³ Waterjetting can also be used to remove contaminants or paint from the surface of mill scale bearing steel (Condition A or B). Photos are not included because the appearance after cleaning is reasonably similar to the initial condition.

Conditions E, F, G, and H are "maintenance" surface conditions. Conditions E and F represent surfaces having aged coatings originally applied over blast-cleaned steel on which the paint is mostly intact. Condition G is deteriorated paint over mill scale bearing steel; Condition H represents surfaces

having deteriorating aged coatings. Although many surfaces encountered in practice may not closely correspond to conditions E, F, G, or H, careful extrapolation of the photographs can aid in determining conformance with the cleaning requirements.

A.2 In 2001, SSPC and NACE are exploring the possibility of splitting SSPC-SP 12/NACE No. 5 into four separate standards such that WJ-1 will be a different standard than WJ-2, and so on. At the time of publication of this visual standard, the four degrees of cleaning by waterjetting are included in SSPC-SP 12/NACE No. 5.

A.3 TEMPERATURE: The temperature of steel substrates can rise during the waterjetting process. Compression of the water to reach jetting pressure creates a temperature increase in the water itself. The water transfers energy to the steel resulting in an increase in the steel's temperature. This temperature increase can be substantial, and may help waterjetted surfaces dry off more quickly, with a corresponding reduction in the severity of flash rust. (See Section A.5).

A.4 REMOVAL OF FLASH RUST: Drying with hot-air blowers or the use of a vacuum are methods to reduce the severity of flash rust. When flash rust is too heavy for a coating application, some coating manufacturers permit its reduction or removal by using clean, hand-held wire brushes or by pressure washing with fresh water. Pressure washing (low-pressure water cleaning) at pressures above 7 MPa (1,000 psi), using either the rotational nozzles or fan jet lances of the waterjetting equipment itself, is a preferred method. It causes the area to re-rust, but it is possible to reduce the degree of flash rust from heavy to light using this method. The appearance of new flash rust resulting from the pressure washing generally does not look like the original flash rust resulting from waterjetting. Hand wire or bristle brushing to remove heavy flash rust may be acceptable for small areas. For large surfaces, mechanical cleaning with power tools can produce acceptable results when the cleaning yields an anchor profile, either imparted or existing, necessary for coating adhesion.

A.5 CHEMICAL CORROSION INHIBITORS: Flash rust can be prevented by the use of corrosion inhibitors. These inhibitors may leave contaminants on the steel surface as the water evaporates. If coatings are applied over this type of surface, a loss of adhesion and/or osmotic blistering can occur. If inhibitors are used, they should be thoroughly washed off with fresh water. It is strongly recommended that the coating manufacturer be contacted to assure the rust inhibitor is compatible with the specific coating system being applied.

A.6 INSPECTING WATERJET CLEANED SURFACES PRIOR TO FLASH RUST: When large areas are cleaned by waterjetting, flash rusting may occur, obscuring the level of visual cleanliness before an inspection can be carried out. The

establishment of the required visual cleanliness, by cleaning and drying a small representative test area prior to production, may help, providing the rest of the job is cleaned to the same degree. Methods for ensuring that the rest of the job is cleaned to the same degree vary from project to project.

A.7 INSPECTING AREAS OF DIFFICULT ACCESS:

Special attention must be given to areas that are difficult to access, such as the backs of stiffening bars. Water cannot be ricocheted into these areas in the same manner as abrasives. Instead, specially designed angled nozzles should be used. These areas should be inspected carefully.

A.8 DISCOLORATION OF CORRODED AND PITTED STEEL: The gray/brown to black discoloration seen on corroded and pitted steel after waterjetting cannot be removed by further waterjetting. Analysis shows that this thin film consists mainly of ferric oxide which is an inert material. Because it is tightly adherent, it does not present a serious contamination problem.

A.9 REMOVAL OF OIL AND GREASE: The waterjetting process can emulsify and remove oil and grease from a surface as it is cleaned. However, this does not preclude the need for proper degreasing procedures as specified in SSPC-SP 1 (Solvent Cleaning)², prior to waterjetting.

A.10 REMOVAL OF SOLUBLE CONTAMINANTS: This Reference Photograph series makes no attempt to define levels of soluble contaminants (salts) remaining on surfaces cleaned by waterjetting, or to relate degrees of flash rust to remaining soluble contaminants. However, the ability to remove chemical contaminants (salts), particularly from badly pitted and corroded steel, is a major advantage of the waterjetting process.



PETROBRAS

DOCUMENTAÇÃO TÉCNICA E LEGAL
ENGENHARIA/SL/DTL

ACKNOWLEDGMENTS

This Guide was prepared by the SSPC/NACE Joint Task Group I on Wet Blast Visual Standards under Chair Lydia M. Frenzel, and was approved by the SSPC C.2 Group Committee on Surface Preparation, chaired by Kenneth A. Trimber and NACE. In accordance with NACE International procedures for developing visual standards, this Guide was also reviewed by a panel of three NACE members and the NACE Technical Practices Committee.

Acknowledgment and thanks are given to the National Shipbuilding Research Program (NSRP) for funding of the draft photographs. Todd Pacific Shipyard and Flow Corporation International were partners in the NSRP project. J.C. Hempel's Skibsfarve-Fabrik A/S provided the photographs used in Condition G from their publication Hempel Protection "Photo Reference Water Jetting." International Paint Company (now International Paint, Inc./Akzo Nobel) provided the flash rusting images from their "International Hydroblasting Standards."

Members of the SSPC/NACE Steering Committee who directed this activity included:

Michael Bentkjaer	Hempel Coatings
Richard Burgess	KTA-Tator, Inc.
Wallace Cathcart	Trinity Industries, Inc.
Monica Chauviere	ExxonMobil Refining and Supply Co.
Richard Dupuy	UHP Projects, Inc.
Lydia M. Frenzel	Advisory Council
Benjamin S. Fultz	Bechtel Corporation
Al Hendricks	Wisconsin Protective Coatings
John Kelly	International Paint, Inc./Akzo Nobel
Carl Mantegna	Chesapeake Specialty Products
Clyde McAfee	Amerada Hess
Wayne Senick	Bridgecote Feroguard Technologies
John Tanner	Ameron International
Ken Trimber	KTA-Tator, Inc.
Max Winkeler	Sigma Coatings USA B.V.
Michael Winter	Sigma Coatings USA B.V.
Jerry P. Woodson, P. E.	Sherwin-Williams Company

Acknowledgement and thanks are also given to members of the NSRP Technical Advisory Committee (TAC) who participated in its initial review, and to members of the waterjetting community who contributed significantly toward the completion of this project.

Additional members of the NSRP Technical Advisory Committee and SP-3 Panel not included in the SSPC/NACE Steering Committee were:

Steven Cogswell	Chesapeake Specialty Products
Brenda Holmes	Naval Sea Systems Command
John Meacham	Peterson Builders
	(Project Manager)

Aimée Beggs, Simon Boocock, Russell Davison, and Ray Weaver of SSPC and Lori Blundell and Pam Huddle of NACE also made significant contributions to the development of this Guide.

The project received strong support from the waterjetting community. Other companies, not mentioned above, that offered direct contributions included:

Aqua-Dyne, Inc.

Butterworth Jetting Systems, Inc.

NLB Corporation

Nozl-Tech, Inc.

Table 1
List of Reference Photographs (Without Flash Rust)
for Various Initial Conditions and for Four Degrees of Cleaning

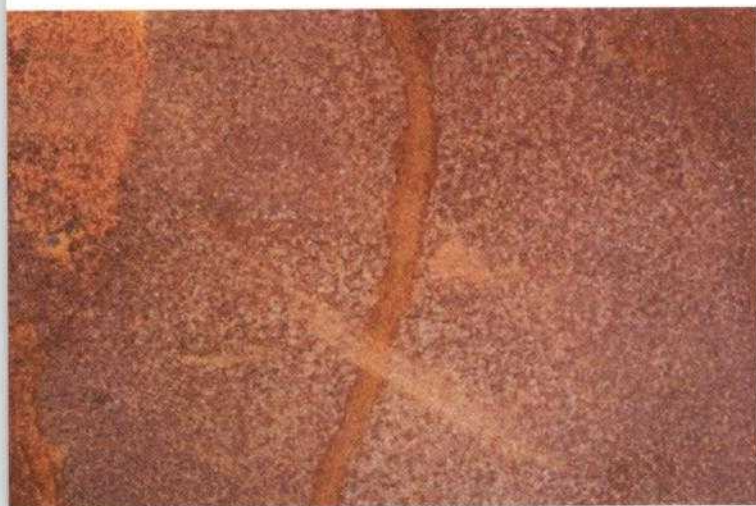
Initial Surface Condition		Condition C 100% Rust	Condition D 100% Rust with pits	Condition E Light-colored paint applied over blast- cleaned steel	Condition F Zinc-rich paint applied over blast- cleaned steel	Condition G Multicoat non-brittle painting system applied over mill scale- bearing steel	Condition H Deteriorated brittle multicoat painting system
Degree of Cleaning	WJ-1	C WJ-1	D WJ-1	E WJ-1	F WJ-1	G WJ-1	H WJ-1
	WJ-2	C WJ-2	D WJ-2	E WJ-2	F WJ-2	G WJ-2	H WJ-2
	WJ-3	C WJ-3	D WJ-3	E WJ-3*	F WJ-3	G WJ-3	H WJ-3
	WJ-4	C WJ-4	D WJ-4	E WJ-4	F WJ-4	G WJ-4	H WJ-4

* E WJ-3 ALT is an alternate illustration of this condition.

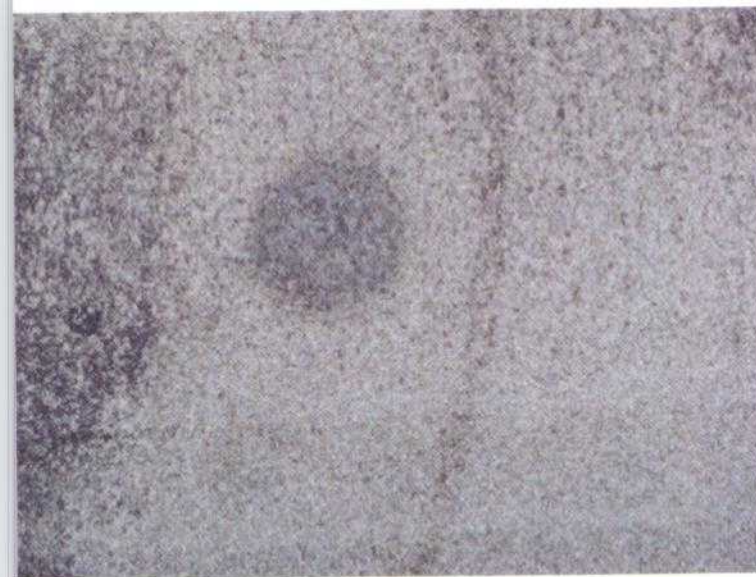
Table 2
List of Reference Photographs Showing Levels of Flash Rust*

Degree of Cleaning	Initial Surface Condition			
	Condition C 100% Rust		Condition D 100% Rust With Pits	
	WJ-2	WJ-3	WJ-2	WJ-3
No Flash Rust	C WJ-2	C WJ-3	D WJ-2	D WJ-3
Light Flash Rust	C WJ-2 L	C WJ-3 L	D WJ-2 L	D WJ-3 L
Moderate Flash Rust	C WJ-2 M	C WJ-3 M	D WJ-2 M	D WJ-3 M
Heavy Flash Rust	C WJ-2 H	C WJ-3 H	D WJ-2 H	D WJ-3 H

* The reference photographs illustrate two initial conditions (rust grades) of mill scale-free, previously unpainted, rusted carbon steel before surface preparation. Each of the photographs showing the initial conditions was selected to show the variations which can be found within the rust grade C and D definitions. The initial condition surfaces are not necessarily the same areas which are depicted in the cleaned condition photographs.



INITIAL CONDITION C



C WJ-4





C WJ-3



C WJ-2



C WJ-1



INITIAL CONDITION D



D WJ-4





D WJ-3



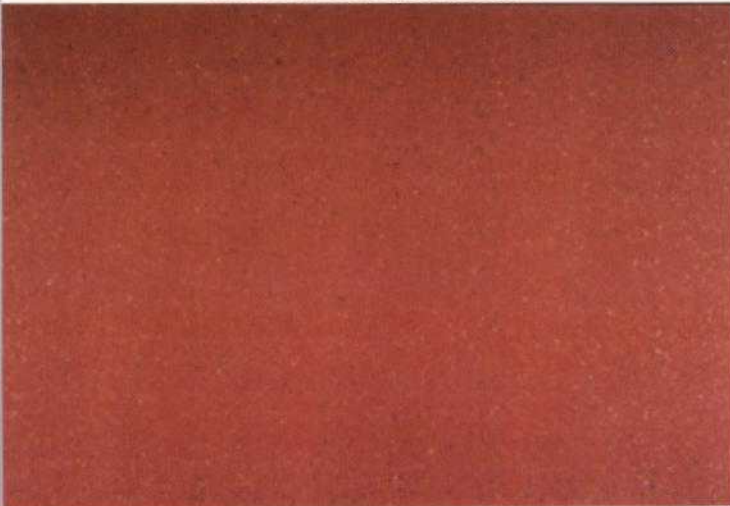
D WJ-2



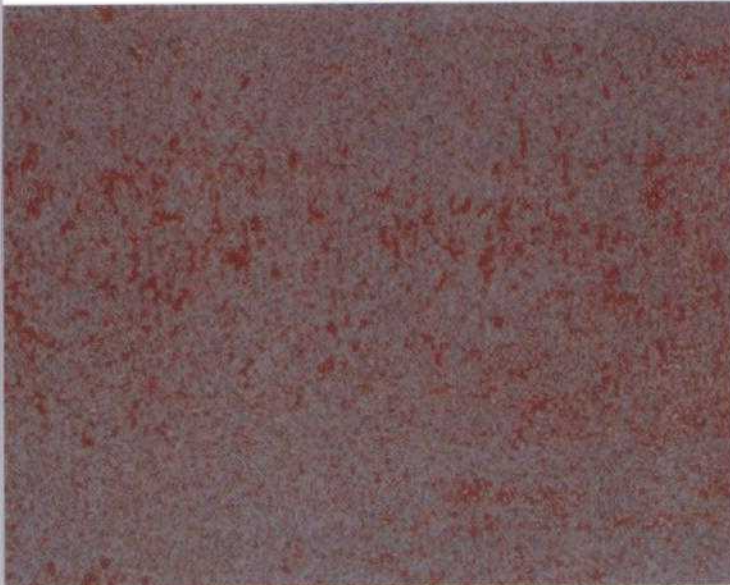
D WJ-1



INITIAL CONDITION E

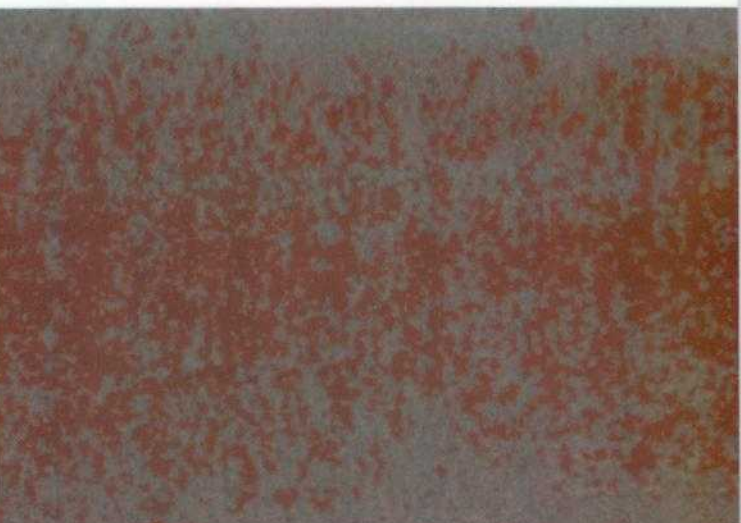


E WJ-4

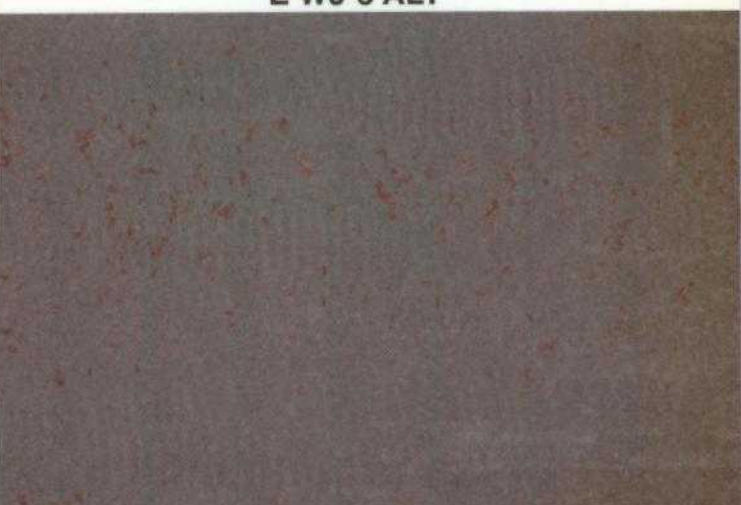


E WJ-3

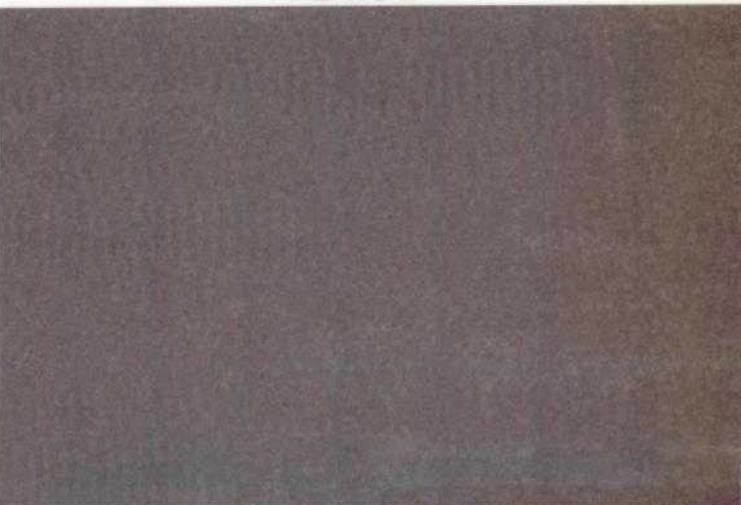




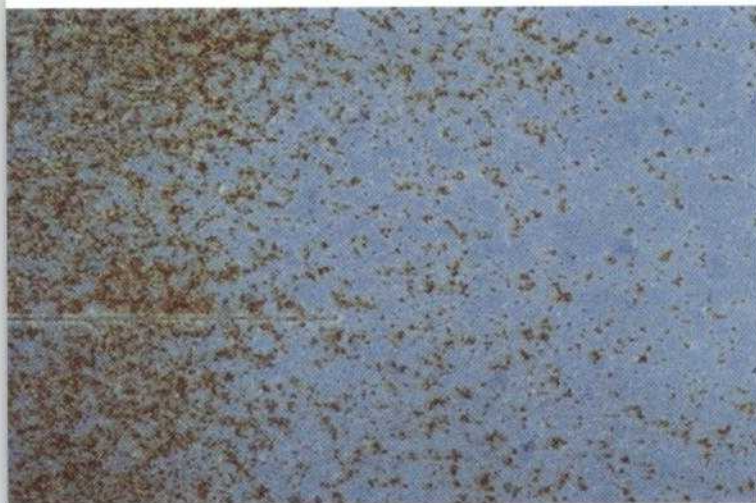
E WJ-3 ALT



E WJ-2



E WJ-1



INITIAL CONDITION F



F WJ-4





F WJ-3



F WJ-2



F WJ-1



INITIAL CONDITION G



G WJ-4





G WJ-3



G WJ-2



G WJ-1



INITIAL CONDITION H



H WJ-4





H WJ-3



H WJ-2



H WJ-1



INITIAL CONDITION C



C WJ-2

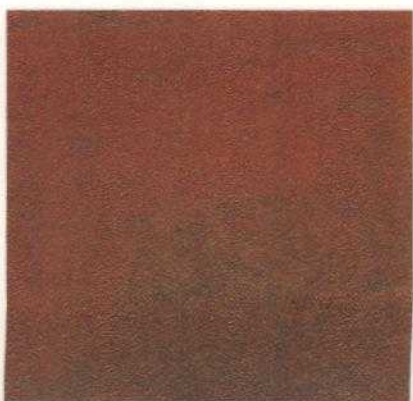




C WJ-2 L



C WJ-2 M



C WJ-2 H



INITIAL CONDITION C



C WJ-3





C WJ-3 L



C WJ-3 M



C WJ-3 H



INITIAL CONDITION D



D WJ-2



D WJ-2 L



D WJ-2 M



D WJ-2 H



INITIAL CONDITION D



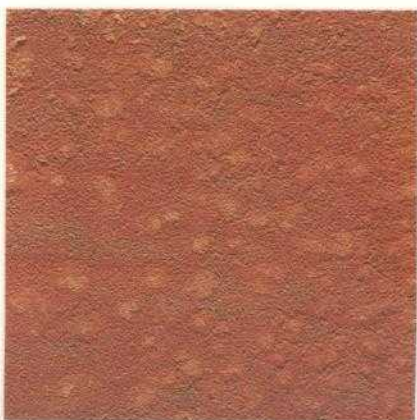
D WJ-3



D WJ-3 L



D WJ-3 M



D WJ-3 H

March 2008