SURFACE PREPARATION:
A COMPARATIVE ANALYSIS
OF EXISTING STANDARDS
A PROPOSED MARINE STANDARD

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FOREWORD

This book results from one of the many projects managed and cost shared by Avondale Shipyards, Inc. in conjunction with the National Shipbuilding Research Program. The program is a cooperative effect between the Maritime Administration's Offic under the direction of SNAME Surface Preparation and Coatring Committee 023-1, Mr. J. W. Peart, Avondale Shipyards, Inc., Chairman/Program Manager.

Ms. Linda Jaekel, Executive Director, Institute of Applied Technology, acted as Project Manager, Principal Investigator and authored this report.

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Thanks is also expressed to SNAME Committee 023, Mr. Niel Miller, Chairman and ASTM Committee F 25.02, Mr. Benfultz,

Chairman, for their lengthly evaluation and critique of the proposed specification.

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Executive Summary

The preparation of metal surfaces for coating in marine environments demands a great deal of attention. Lack of properly prepared surfaces can result in rapid corrosion and high cost.

Many standards exist to define the surface appearance and the means of achieving the specified level of cleanliness. However, surface preparation is not an exact science and the existing standards for abrasive blast cleaning to white, near-white, and commercial levels of cleanliness are not necessarily adequate for covering the needs of marine environments.

This paper reviews and comments on some of the existing standards and specifications for abrasive blast cleaned surfaces as applied to white, near-white, and commercial finishes, as well as summarizing selected other resources dealing with this topic. Three proposed standards are included here, in an attempt to better define the above mentioned levels of surface cleanliness for use in the marine industry.

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SECTION 1

Introduction

1. INTRODUCTION

1.1 Project Scope

The marine industry, while acknowledging the inability of perfactly defining surface cleanliness to cover every occasion, preceives a need for improved standards on abrasive blast cleaning to white, near-white, and commercial finishes. In response to this need, the Ship Production Committee, panel 023-1 on Surface Preparation and Coatings, undertook this project to evaluate existing standards and to propose new standards dealing with the above mentioned topics.

The goal of this project was to have a comprehensive review of the different surface preparation standards used in the marine industry, to see where the deficiencies lay and from this to propose three new standards which are better suited to the marine industry.

Twelve different, commonly used, standards were examined and compared for content scope. Eight of these standards are summarized in Chart 2. Additional sources which examine the various standards were also reviewed here. After the examination of the standards and other sources, three new proposed surface preparation standards were developed for white, near-white, and commercial blast cleaned surfaces.

1.2 Background

Of the various standards and specifications which exist and are used by the marine industry, the Steel Structures Painting Council (SSPC) specifications are perhaps among the most common. Many shipyards blast to a white (SP-5), near-white (SP-10), or commercial (SP-6) finish according to the provisions of the 1963 SSPC specifications.

In 1982, SSPC introduced revisions to these specifications, causing consternation in the marine industry. Although the 1963 versions could stand improvement, the new versions were felt to be less applicable to the marine environment than the 1963 specifications. A primary objection, as voiced by the Society of Naval Architects and Marine Engineers (SNAME), is with the lack of specificity found in the new documents.

These objections, and a comparison of the 1982 revisions to the 1963 specifications, are well laid out in a paper by Neil Miller and Walter Radut (see 2.1.5) under the auspices of SNAME panel 023. A particular point to be observed is that many vital areas are not included in the 1982 SSPC specifications, but are left to a separate commentary section.

There is concern in the marine community that the 1982 version being less definitive and more permissive in some requirements might result in less than the quality surface required for marine coatings to perform effectively for their expected service life. Due to this situation, the Ship Production Committee, panel 023-1 undertook this project to examine what exists, and to propose some additional surface preparation standards - found in section 4 of this report.

Subsequent to the initiation of this project SSPC has convened a committee to revise the subject specifications. Hopefully the result will be specifications that will fulfill the requirements of the marine community as well as the other sections of the steel fabrication industry. The proposed specifications contained herein, while not being a finalized concensus document has been reviewed by cognizant industry groups. It can be utilized by the SSPC specification committee as a guide.

SECTION 2

Review of Standards

2. REVIEW OF STANDARDS

2.1 Review and Commentary on Surface Preparatlon Standards

The twelve different standards reviewed in this section differ according to content concentration and style of presentation. These standards are the most commonly used in the marine industry, and cover both written and visual standards. Chart 2 provides a quick reference to eight of the different standards according to the content coverage.

2.1.1 ASTM D 610-68 "Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces", American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (1974)

This standard is a supportive written document to SSPC Vis-2-68T. As well as describing the rust grades covered in the diagrams, ASTM provides some helpful precautions when interpreting rusting and applying the pictorial representations.

2.1.2 ASTM D 2200-67 “Standard Pictorial Surface Preparation Standards for Painting Steel Surfaces” (1974)

ASTM references the Swedish standard (SIS 05 59 00) here and provides a brief description of the pictorial representations.

2.1.3 ASTM D 3276-80 "Standard Guide for Paint Inspectors" (1980)

Sections 3.4, 3.5, and 3.6.1 apply to surface preparation of steel. Topics covered here are cleaning the surface of foreign matter, why mill scale is a source of trouble, surface profile, and blast cleaning as well as other cleaning

procedures.

Levels of surface cleanliness (white, near white, and commercial) are compared as to the conditions which would require each different level. Both primary and secondary surface preparation are covered as well as new and old steel situations. A brief mention is given to equipment and abrasives.

2.1.4 BS 4232:1967 “British Standard Specification for Surface Finish of Blast-Cleaned Steel For Painting”, British Standards Institution, 2 Park Street, London WIA 2BS, England (1967)

This British standard emphasizes the quality of surface finish of blast cleaned steel and defines first, second, and third quality finishes while relating these finishes to the coating system to be used. Diagrams indicating second and third quality finishes are included. The difficulty of obtaining a first quality finish when steel is corroded is pointed out here.

Substantial detail is given to the types and grades of metallic and non-metallic abrasives and includes a table. It is specified that this standard is only for dry blasting techniques, and NOT for wet blasting.

Surface profile and methods of measuring surface roughness are covered. An aspect of secondary preparation unique to this standard is to rub the surface with a nylon scraper or scouring pad after removing abrasive material, in order to reduce the number of “rogue peaks”.

New and aged steel, primary and secondary preparation are all part of this standard. However, it gives less detail than some other standards as to the various elements involved in primary and secondary preparation.

2.1.5 JSRA 1975 “Standard for the Preparation of Steel Surface Prior to Painting”, Shipbuilding Research Association of Japan, 139th Research Section (1975)

This visual standard includes a series of 92 pictorials, covering both primary and secondary preparation (in before and after shots of the same surface) of new steel. Under primary surface preparation, differentation is given according to abrasives used and levels of surface cleanliness. The secondary level, beginning with steel covered by 3 different types of shop primers and exposed to weather for 1 1/2 months in 5 damage types, differs the samples according to type of surface preparation and level of surface cleanliness.

JSRA visuals are more comprehensive in scope than the Swedish, and use the same steel surface for both the primary and the secondary situations. However, these pictures can be complicated to interpret, and some questions arise as to the applicability of the weathering conditions and time frame.

2.1.6 NACE Standard RP-01-72 “Surface Preparation of Steel and Other Hard Materials by Water Blasting Prior to Coating or Recoating”, National Association of Corrosion Engineers, P.O. Box 1499, Houston, TX 77001 (1972)

Whereas the British standard specifically excludes any wet blasting, this standard is devoted to water blasting. Topics include equipment to be used, inhibitors, safety, as well as. 2 tables detailing the time involved to blast uncoated and coated steel. Eight conditions are listed where water blasting has been found to be successful.

A limitation noted in this standard is “Because water blasting has no abrasive effect on steel or other hard surfaces and does not provide an anchor pattern for coating adhesion, its use is recommended primarily in maintenance painting programs.[n].

2.1.7 NACE Standards TM-01-70\75:

a. TM-01-70 “Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive[n] (1970)

b. TM-01-75 “Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Shot” (1975)
c. TM-01-75 “Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grit” (1975)

These visual representations of new steel surfaces are differentiated by the level of surface cleanliness and by dry blast cleaning according to type of abrasive.

The situations covered by these standards are fairly specific as the scope is rather narrow.

2.1.8 SIS 05 59 00 - 1967 “Pictorial Surface Preparation Standards for Painting Steel Surfaces”, Swedish Standards Institution, Box 3295, Stockholm 3, Sweden (1967)
(SSPC Vis-1-67T)
(ASTM D2200-67)

This standard is a series of 24 pictorials and includes 4 rust grades before surface preparation as well as showing the surface after various cleaning procedures to 4 levels of surface cleanliness. These pictures deal with primary surface preparation for new steel (the 4 rust grades all deal with mill scale) .

The Swedish standard does not qualify the surface quality according to various blast cleaning equipment, nor by various types of abrasives. The same surface is not used in the before and after pictures.

2.1.9 SNAME Technical & Research Bulletin No. 4-9 “Abrasive Blasting Guide for Aged or Coated Steel Surfaces”, Society of Naval Architects and Marine Engineers, One World Trade Center, New York, NY 10048 (1969)

The SNAME visuals cover abrasive blasting of aged/coated mild and tensile steel surfaces, depicting the original

condition of each surface and the blasted surface at different qualities. Surface conditions of the steel include mill scale, rust, old paint, and severe corrosion.

No attention is given to secondary preparation, abrasives, or equipment used - other than to recommend only dry blasting methods be used for white, near white, and commercial finishes.

2.1.10 SSPC Vis 2-68T “Standard Methods of Evaluating Degree of Rusting on Painted Steel Surfaces”, Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15213 (1982)

The scope of this visual standard is limited to grades of rusting on coated steel surfaces. There are 9 diagrams depicting percentage of surface area rusted.

2.1.11 SSPC SP 5/6/10-63, (1963):

a. SP 5-63 “White Metal Blast Cleaning”
b. SP 6-63 “Commercial Blast Cleaning”
c. SP 10-63 “Near White Blast Cleaning”

These 3 specifications define levels of surface cleanliness for white, near white, and commercial finishes. Both primary and secondary surface preparation are covered for new and aged steel. Methods of cleaning are stratified by abrasives and equipment. Abrasive type and size are related to profile height in a table in the appendix. Surface profile, safety, and inspection are additional areas given good coverage in this specification.

These specifications have quite a bit of relevant information in their respective appendixes rather than in the text.

2.1.12 SSPC SP 5/6/10-82, (1982):

a. SP 5-82 “White Metal Blast Cleaning”

b. SP 6-82 “Commercial Blast Cleaning”

c. SP 10-82 “Near White Blast Cleaning”

The 1982 specifications differ from the 1963 versions. Less coverage is given to primary preparation, secondary preparation, types and grades of abrasives, and safety. No mention is made of time factors or surface profile. The 1982 version does include a discussion on the cleanliness of abrasives not found in the 1963 specifications.

A section entitled ‘notes’ in the 1982 specifications refers the user to a separate commentary for various relevant subjects. It is felt that the commentary contains a lot of important information which should have been discussed in the specifications rather than treated in a separate document.

2.1.13 SSPC “Surface Preparation Commentary”, Steel Structures Painting Manual, pp. 11-26 (1982)

While this commentary is not a specification, it is included in this section because it is a highly supportive document to the SSPC SP 5/6/10-82 specifications. The intent of this commentary is "to be an aid for selecting the proper surface preparation specifications for a given job and for determining when the desired surface preparation is accomplished .“.

This document gives some review of SSPC Vis-1-67T, SSPC Vis-2-68T, SSPC SP 5-82, SSPC SP 6-82, and SSPC SP 10-82 among other SSPC specifications.

There is excellent coverage given to surface imperfections as well to secondary preparation; inhibitors and rust-back. Surface profile, abrasive types, and grades of abrasives are discussed and supported with various tables.

Note: These summaries are not necessarily comprehensive in covering all subjects mentioned. Rather, they are limited to those topics found in Table 2 (Topic Review of Selected

Specifications and Standards) and to the 3 levels of surface cleanliness found in Table 1 (Comparative Designations For Blast Cleaned Surfaces).

2.2 Future Standards

The following organizations are currently developing, or planning to develop (SSPC) new standards on surface preparation.

2.2.1. International Standards Organization

The International Standards Organization, subcommittee TC35/S12 is working on developing a new international standard on surface preparation. The scope is to establish a series of test methods to assess surface quality, establish standards for surface quality, and the means of achieving the established surface qualities.

2.2.2. SSPC revisions to the 1982 specifications

SSPC is tentatively planning to revise their 1982 specifications on white, near white, and commercial blasting so as to make the content more definitive and applicable to the marine industry.

2.2.3. SNAME update to TR 4-9 pictorials

SNAME is in the process of developing a new series of pictorials and text on surface preparation. The new document will also deal with aged or previously ‘coated steel surfaces, and will include welds and burns.

2.3 General Comments

2.3.1 Topics Covered

By examining Chart 2, one can see what is included or omitted in many of the specifications and standards reviewed here. While the scope of each differs, especially between the categories of visual and written, each could be more comprehensive in nature. A new standard could be developed to be inclusive of the areas of mention on Chart 2 and to combine both written and visual styles of presentation.

In any case, because these standards do touch on different items, there should be a central resource to readily access them and other supportive materials.

2.3.2 Organization

The initial condition of the steel, new construction versus aged or previously coated steel, lead to some different considerations in primary preparation and secondary preparation. A possible structure for those standards which deal with both conditions would be to organizationally differentiate between them when discussing achieving the different levels of surface cleanliness, primary preparation, and secondary preparation.

Surface profile, equipment, abrasives, time element, safety, inspection and other relevant topics could then be covered together as pertaining to both new and aged steel.

2.3.3 Audience

These specifications and standards seem primarily positioned toward the engineer and staff level personnel. There is yet another audience, the foremen and other supervisory personnel in the yard and shop, who would benefit from standards which are both accessible and understandable at that level.

CHART 1

Comparative Designations for Blast Cleaned Surfaces

Standards	Levels of Blast Cleaned Surfaces		
1. SSPC	White	Near-White	Commercial
2. Swedish	SA 3	SA 2½	SA 2
3. British	First Quality	Second Quality	Third Quality
4. NACE	No. 1	No. 2	No. 3
5. Japanese*	Sh/Sd 3 (?)	Sh/Sd 2 (?)	Sh/Sd 1 (?) (picture unavailable)

* These levels of surface cleanliness in the Japanese pictorials appear similiar to the other above mentioned designations.

CHART 2

Topic Review of Selected Specifications and Standards

AREAS OF MENTION	Swedish SIS OS 5900 - 1967	Japanese JSRA 1975	NACE TM 01-07/75	SNAME 4-9 1969	SSPC Vis - 2 68 T	British BS 4232:1967	SSPC '63 SSPC SP 5/6/10-63	SSPC '82 SSPC SP 5/6/10-82	SSPC '82 Commentary [B]
1. Primary Presentation									
a. written						✓	✓	✓	✓
b. visual	✓	✓	✓	✓	✓				
2. Surface Descriptions [A]									
a. white	✓	✓	✓	✓		✓	✓	✓	✓
b. near-white	✓	✓	✓	✓		✓	✓	✓	✓
c. commercial	✓	✓	✓	✓		✓	✓	✓	✓
3. Condition of Steel									
a. new construction	✓	✓	✓			✓	✓	✓	✓
b. aged or coated				✓	✓	✓	✓	✓	✓
4. Primary preparation									
a. mill scale	✓	✓		✓			✓		
b. rust	✓	✓		✓	✓	✓	✓		
c. other foreign matter		✓		✓		✓	✓		
d. surface imperfections	✓	✓		✓					✓
5. Secondary preparation									
a. repair and damage						✓		✓	
b. clean up						✓	✓	✓	
c. inhibitors		✓					✓	✓	
d. rust back		✓					✓		
6. Time factor						✓	✓		
7. Abrasives									
a. types		✓	✓			✓	✓		
b. grades						✓	✓		
c. cleanliness								✓	
8. Equipment									
a. compressed air	✓		✓			✓	✓	✓	
b. centrifugal wheel			✓				✓	✓	
c. wet blasting							✓	✓	
9. Surface Profile						✓	✓		
10. Safety							✓	✓	
11. Inspection						✓	✓	✓	

A or equivalent designations as found on Chart 1

B While this document is not a standard, it is included in this section because SSPC SP/5/6/10 - 82 specs depend rather heavily on this for adequate coverage.

SECTION 3

Selected Resources

3. Selected Resources

3.1 summary of Selected Resources

3.1.1 McKelvie, A.N. “Evaluation of Various Cleaning Processes for Steel”, Paint Research Association, Waldegrave Road, Teddington, Middlesex TWll 8LD, England (1977)

In this paper, McKelvie relates the usefulness of cleaning processes for steel to the cleaning requirements, as follows:

1. Cleaning of steel at the steelmill.
2. Cleaning of rusty steel stock.
3. Cleaning of fabricated steelwork.
4. Cleaning for maintenance.

After defining the 4 basic cleaning requirements, he discourses in depth on chemical, dry abrasive blasting (air and centrifugal) , and wet cleaning methods.

3.1.2 McKelvie, A.N. “Preparation of Steel Substrates before Application of Paint and Related Products”, Paint Research Association (1981)

This work discusses the activities of the 3 working groups of the International Standards Organization subcommittee TC35/SC12 to establish test methods and standards for surface quality in a proposed international standard. The 3 working groups are devoted to:

Group 1: Surface Profile
Group 2: Surface Cleanliness
Group 3: Surface Preparation Techniques

3.1.3 McKelvie, A.N. “Steel Cleaning Standards - A Case for Their Reappraisal”, Paint Research Association (1976)

The following specifications and standards are given an

extensive review in this paper:

- SSPC SP 5/6/10-63,
- Swedish pictorials (SIS 05 59 00-1967), and
- British standard (BS 4232:1967).

A major criticism McKelvie has of the above standards is that they lack an explanation of the rusting process and of tests necessary to determine the absence of colorless ferrous salts.

He also mentions that SSPC SP 5-63 is misleading when it indicates that white metal can be obtained by several blast cleaning methods. McKelvie points out that steel shot is not very effective in removing rust and that grit is the better abrasive for it.

His criticism of SSPC specifications and the Swedish pictorials is that the difficulty of obtaining a white metal finish except on new steel is not emphasized, and that the constraints should be mentioned.

3.1.4 McKelvie, A.N. and Nigel Whitehouse “Quality Control Procedures When Blast Cleaning Steel”, Paint Research Association (1980)

This paper deals with surface profile and cleanliness and is a step toward a new international standard through the International Standards Organization. The Swedish standard is again reviewed in some detail, while pointing to the danger of relying solely on visual standards. Rust and surface profile are topics treated in some depth by McKelvie.

Rust is the main thrust in the first chapter, and includes discourse on flash rusting and rust-back. Surface profile includes definitions of related terminology and methods of measuring surface texture. Tests for determining whether harmful contaminants are left on the surface comprise the final portion of this work.

3.1.5 Miller, Neil M. and Walter H. Radut, “Application of 1982 SSPC Surface Preparation Standards to the

Marine Industry", Society of Naval Architects and Marine Engineers, Committee 023, One World Trade Center, New York, NY 10048 (1982)

The authors developed this paper as a response to the then proposed 1982 SSPC specifications for white, near white, and commercial levels of surface cleanliness. The focus here is a critique of the new specifications, comparing them to the 1963 specifications. Miller and Radut felt that SSPC left out vital information and were too general in the newer versions. There is a comprehensive and quite specific critique and comparison of the 2 versions.

The last part of this paper deals with recommendations to improve the SSPC specifications. Suggested areas include:

- functions of surface preparation,
- surface imperfections (weld spatter, porosity, sharp edges, pits, laminations/slivers, and crevices), and
- safety precautions.

3.1.6 NACE Publication 6G176 "Cleanliness and Anchor Patterns Available Through Centrifugal Blast Cleaning of New Steel", National Association of Corrosion Engineers, P.O. 1499, Houston, TX (1976)

This report provides some very detailed information on 4 levels of surface cleanliness in terms of profile height, surface roughness, and peak count by different abrasives used in a centrifugal blast cleaning process. Extensive tests were conducted to determine surface profile in relation to the different levels of surface cleanliness, types of steel, types of abrasive, and different angles of abrasive impact. Two tables in this report complement the descriptive information on the test results.

3.1.7 NACE TPC Publication No. 2 "Surface Preparation of Coatings for Immersion Service" Chapter 2 (1972)

This chapter on surface preparation provides some good discourse on different aspects of surface preparation. It is "concerned with surface preparation of steel and concrete to receive linings. The linings are for protection of substrate from tank contents or for protection of the contents from contamination by elements of the substrate." NACE definitions of different levels of surface cleanliness are provided. Abrasive properties (size, shape, chemical components color, weight, availibility, cost, and types) are considered, with some detail on testing various abrasive properties. Time factors, inspection safety and some primary preparation techniques are additional areas included here.

3.1.8 "Practical Shipbuilding Standards for Surface Preparation and Coatings", U.S. Department of Transportation, Maritime Administration (1979)

Sections 2.4.1 (Definition of Standards) and 4 (Practical Shipbuilding Surface Preparation and Coatings Standard) are relevant to surface preparation. Various standards, including American, British, Japanese, Swedish, and French are given a cursory review in the section 2.4.1.

Part of the standard (section 4) deals with surface preparation. A chart is provided with comparative designations (British, Swedish, SSPC, and NACE) for levels of surface cleanliness, as well as a reference section to various visual standards. The need for a surface cleaned of foreign matter and correcting surface imperfections are covered here.

SECTION 4

Proposed Standards

4. Proposed Standards

The following three proposed standards are only preliminary working. Members of the Society of Naval Architects and Marine Engineers (SNAME) , Ship Production Committee panel 023-1 reviewed an initial draft on near-white in March 1983 and further drafts on white, near-white, and commercial finishes in June of 1983. This June meeting was in conjunction with the American Society for Testing and Materials (ASTM) group F25-02, whose members also reviewed and revised the above standards.

SNAME 023 members examined and commented on the initial near-white draft in March, 1983 during a meeting in New York. Recommendations made at that time indicate a desire for greater specificity in the standards; for example, the removal of surface imperfections. The members at the June meeting of SNAME 023-1 and ASTM F25-02 felt that this was unnecessary detail for describing the surface appearance.

Thus, when reviewing these proposed standards, one should keep in mind the purpose, that of describing the surface appearance when blast cleaned to the different levels. Additional standards can be used to deal with the multitude of related topics in surface preparation, such as removal of various surface imperfections.

The standards presented here represent a consensus reached by members present at the ASTM F25-02 and SNAME 023-1 meetings in Seattle, WA on June 23, 1983. It was recognized that there remain many areas open for discussion after the initial analysis.

This section contains proposed standards on white metal, near-white, and commercial blast cleaning followed by the two applicable documents referenced in the standards.

PROPOSED SURFACE PREPARATION STANDARD
WHITE METAL BLAST CLEANING

1. Scope

1.1 This standard defines white metal blast cleaned steel surfaces before painting or coating, by the use of abrasives (sand, grit, or shot) propelled through nozzles or by centrifugal wheels.

1.2 The primary functions of blast cleaning are:

- to remove material from the surface that will cause early failure of the paint system,
- to provide a surface that can be easily wetted for good coating adhesion, and
- to obtain a good surface profile to anchor the coating.

1.3 White metal blast cleaning is the highest level of blast cleaning. It is usually specified for areas which will be subjected to the most severe conditions and where the highest performance of the coating systems is required.

2. Applicable Documents

2.1 ASTM Standard D 2200 “Pictorial Surface Preparation Standards for Painting Steel Surfaces”. Annual Book of ASTM Standards, Part 27.

2.2 Steel Structures Painting Council (SSPC) specification SP-1 “Solvent Cleaning”. Available from the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15213.

3. Descriptions of Terms

3.1 White metal blast cleaning is a method of preparing steel surfaces for painting or coating which, when viewed without magnification will leave the surface free of all visible oil, grease, dirt, dust, mill scale, rust, paint,

oxides, corrosion products, and other foreign matter.

3.2 The surface shall be blasted to a grey white metallic color. The particular type of abrasive used may affect the appearance of the surface. A white metal blasted surface shall be uniform in its degree of cleanliness.

Note 1: The surface finish obtainable depends a great deal on the prior surface condition. Achieving a white metal finish is unlikely if the steel is deeply pitted or severely corroded before blast cleaning, even though all contaminants appear to have been removed.

4. Appearance

4.1 The surface shall be roughened to a degree suitable for the specified coating system. The anchor pattern profile is limited to a range recommended by the coating manufacturer.

4.2 The appearance of the surface may be affected by the particular blasting abrasive used. The color of the steel may differ because of the grade, original surface condition, shape of the material being cleaned, discolorations from mill or fabrication marks, and shadowing from blast cleaning operations.

4.3 Photographic standards of comparison, such as ASTM 2200, may be used as a guide to define the final surface appearance.

5. Procedures Before Blast Cleaning

5.1 Remove visible deposits of oil, grease, or other contaminants by methods specified in SSPC SP-1 “Solvent Cleaning”.

5.2 Weld spatter, welding slag, and burning slag should be removed before blast cleaning by using a chipping hammer, spud bar or scraper. Tightly adhering weld spatter may require removal by grinding.

6. Blast Cleaning Methods and Operations

6.1 Suggested Methods

6.1.1 Dry blasting using compressed air blast nozzles and abrasive.

6.1.2 Dry blasting using a closed cycle, recirculating abrasive system with centrifugal wheels and abrasive.

6.1.3 Dry blasting using a closed cycle, recirculating abrasive system with compressed air blast nozzle and abrasive, with or without vacuum for dust and residue recovery.

6.1.4 Wet blasting using compressed air blast nozzles, water, and abrasive followed by rinse.

6.2 Operation

6.2.1 When compressed air is used for nozzle blasting, use and maintain moisture separators, oil separators, and traps to provide a clean, dry air supply.

7. Procedures After Blast Cleaning

7.1 Remove visible dust and loose residues caused by dry abrasive blast cleaning.

7.2 If the surface was wet abrasive blast cleaned, rinse with fresh water to which enough corrosion inhibitor has been added to prevent rusting, or with fresh water followed by an inhibitive treatment approved by the coating manufacturer.

7.3 The blast cleaned surface shall be further treated or primed, as specified in the contract, preferably within 24 hours after blast cleaning, and before any visible or detrimental rusting occurs. Where chemical contamination of the surface may occur, the steel shall be painted as soon as possible after blast cleaning.

7.4 If any rust forms after blast cleaning, the surface must be reblast cleaned before coating. Note: Alternate repair methods, if agreed upon by the contracting parties, may be substituted.

8. Blast Cleaning Abrasives

8.1 The abrasive (sand, grit, or shot) must be dry and free of contaminants oil, grease, or other harmful elements.

8.2 Selection of the abrasive size and type is based on the type of steel, grade of steel, surface condition of the steel, the finished surface to be produced, and the coating system to be used.

9. Inspection

9.1 Inspection of the surface shall be agreed upon by the contracting parties.

10. Safety Precautions

10.1 If fire or exposion hazards are present, proper precautions shall be taken before any work is done.

10.2 Approved helmets, respirators, and other protective gear shall be provided to all workers and others exposed to blast dust, flying objects, or paint spray environment.

10.3 Blast hose shall be grounded to dissipate static charges.

10.4 Safety procedures shall follow any applicable federal, state, and local rules as well as requirements of insurance underwriters.

PROPOSED SURFACE PREPARATION STANDARD
NEAR-WHITE BLAST CLEANING

1. Scope

1.1 This standard defines near-white blast cleaned steel surfaces before painting or coating, by the use of abrasives (sand, grit, or shot) propelled through nozzles or by centrifugal wheels.

1.2 The primary functions of blast cleaning are:

to remove material from the surface that will cause early failure of the paint system,

to provide a surface that can be easily wetted for good coating adhesion, and

to obtain a good surface profile to anchor the coating.

1.3 Near-white blast cleaning is used where a high level of blast cleaning is required. It is most commonly used prior to the first application of high-performance coating systems. It may also be specified for secondary surface preparation of burned or damaged areas during construction as well as for surface preparation of previously coated or failed coated areas before reapplying high-performance coatings systems.

2. Applicable Documents

2.1 ASTM Standard D 2200 "Pictorial Surface Preparation Standards for Painting Steel Surfaces". Annual Book of ASTM Standards, Part 27.

2.2 Steel Structures Painting Council (SSPC) specification SP-1 "Solvent Cleaning". Available from the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15213.

3. Descriptions of Terms

3.1 Near-white blast cleaning is a method of preparing

steel surfaces for painting or coating which, when viewed without magnification will leave the surface free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter.

3.2 NO MORE THAN 5% OF EACH SQUARE INCH OF SURFACE AREA may show light shadows, slight streaks, or minor discolorations. These are caused by stains of rust, stains of mill scale, or stains of previously applied paint. Note: Some types of steel will show non-uniformity of color even though fully cleaned.

4. Appearance

4.1 The surface shall be roughened to a degree suitable for the specified coating system. The anchor pattern profile is limited to a range recommended by the coating manufacturer.

4.2 The appearance of the surface may be affected by the particular blasting abrasive used. The color of the steel may differ because of the grade, original surface condition, shape of the material being cleaned, discolorations from mill or fabrication marks, and shadowing from blast cleaning operations.

4.3 Photographic standards of comparison, such as ASTM 2200, may be used as a guide to define the final surface appearance.

5. Procedures Before Blast Cleaning

5.1 Remove visible deposits of oil, grease, or other contaminants by methods specified in SSPC SP-1 “Solvent Cleaning”.

5.2 Weld spatter, welding slag, and burning slag should be removed before blast cleaning by using a chipping hammer, spud bar, or scraper. Tightly adhering weld spatter may require removal by grinding.

6. Blast Cleaning Methods and Operations

6.1 Suggested Methods

6.1.1 Dry blasting using compressed air blast nozzles and abrasive.

6.1.2 Dry blasting using a closed cycle, recirculating abrasive system with centrifugal wheels and abrasive.

6.1.3 Dry blasting using a closed cycle, recirculating abrasive system with compressed air blast nozzle and abrasive, with or without vacuum for dust and residue recovery.

6.1.4 Wet blasting using compressed air blast nozzles, water and abrasive followed by rinse.

6.2 Operation

6.2.1 When compressed air is used for nozzle blasting, use and maintain moisture separators, oil separators, and traps to provide a clean, dry air supply.

7. Procedures After Blast Cleaning

7.1 Remove visible dust and loose residues caused by dry abrasive blast cleaning.

7.2 If the surface was wet abrasive blast cleaned, rinse with fresh water to which enough corrosion inhibitor has been added to prevent rusting, or with fresh water followed by an inhibitive treatment approved by the coating manufacturer.

7.3 The blast cleaned surface shall be further treated or primed, as specified in the contract, preferably within 24 hours after blast cleaning, and before any visible or detrimental rusting occurs. Where chemical contamination of the surface may occur, the steel shall be painted as soon as possible after blast cleaning.

7.4 If any rust forms after blast cleaning, the surface must be reblast cleaned before coating. Note: Alternate repair methods, if agreed upon by the contracting parties, may be substituted.

8. Blast Cleaning Abrasives

8.1 The abrasive (sand, grit, or shot) must be dry and free of contaminants, oil, grease, or other harmful elements.

8.2 Selection of the abrasive size and type is based on the type of steel, grade of steel, surface condition of the steel, the finished surface to be produced, and the coating system to be used.

9. Inspection

9.1 Inspection of the surface shall be agreed upon by the contracting parties.

10. Safety Precautions

10.1 If fire or exposion hazards are present, proper precautions shall be taken before any work is done.

10.2 Approved helmets, respirators, and other protective gear shall be provided to all workers and others exposed to blast dust, flying objects, or paint spray environment.

10.3 Blast hose shall be grounded to dissipate static charges.

10.4 Safety procedures shall follow any applicable federal, state, and local rules as well as requirements of insurance underwriters.

PROPOSED SURFACE PREPARATION STANDARD
COMMERCIAL BLAST CLEANING

1. Scope

1.1 This standard defines commercial blast cleaned steel surfaces before painting or coating by the use of abrasives (sand, grit, or shot) propelled through nozzles or by centrifugal wheels.

1.2 The primary functions of blast cleaning are:

- to remove material from the surface that will cause early failure of the paint system,
- to provide a surface that can be easily wetted for good coating adhesion, and
- to obtain a good surface profile to anchor the coating.

1.3 Commercial blast cleaning is used where a moderate level of blast cleaning is required. It is generally used with coatings which tolerate a lower degree of blast cleaned surfaces.

2. Applicable Documents

2.1 ASTM Standard D 2200 "Pictorial Surface Preparation Standards for Painting Steel Surfaces". Annual Book of ASTM Standards, Part 27.

2.2 Steel Structures Painting Council (SSPC) specification

SP-1 "Solvent Cleaning". Available from the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15213.

3. Descriptions of Terms

3.1 Commercial blast cleaning is a method of preparing steel surfaces for painting or coating which, when viewed

without magnification, will leave the surface free of all visible oil, grease, dirt, dust, rust scale, and other foreign matter.

3.2 NO MORE THAN 33% OF EACH SQUARE INCH OF SURFACE AREA may show slight shadows, streaks, or discolorations caused by rust stains, mill scale oxides, or slight tight residues of coating that may remain. If the original surface is pitted, slight residues of rust and old coating may remain in the bottom of pits.

4. Appearance

4.1 The surface shall be roughened to a degree suitable for the specified coating system. The anchor pattern profile is limited to a range recommended by the coating manufacturer.

4.2 The appearance of the surface may be affected by the particular blasting abrasive used. The color of the steel may differ because of the grade, original surface condition, shape of the material being cleaned, discolorations from mill or fabrication marks, and shadowing from blast cleaning operations.

4.3 Photographic standards of comparison, such as ASTM 2200, may be used as a guide to define the final surface appearance.

5. Procedures Before Blast Cleaning

5.1 Remove visible deposits of oil, grease, or other contaminants by methods specified in SSPC SP-1 “Solvent Cleaning”.

5.2 Weld spatter, welding slag, and burning slag should be removed before blast cleaning by using a chipping hammer, spud bar, or scraper. Tightly adhering weld spatter may require removal by grinding.

6. Blast Cleaning Methods and Operations

6.1 Suggested Methods

6.1.1 Dry blasting using compressed air blast nozzles and abrasive.

6.1.2 Dry blasting using a closed cycle, recirculating abrasive system with centrifugal wheels and abrasive.

6.1.3 Dry blasting using a closed cycle, recirculating abrasive system with compressed air blast nozzle and abrasive, with or without vacuum for dust and residue recovery.

6.1.4 Wet blasting using compressed air blast nozzles, water, and abrasive followed by rinse.

6.2 Operation

6.2.1 When compressed air is used for nozzle blasting, use and maintain moisture separators, oil separators, and traps to provide a clean, dry air supply.

7. Procedures After Blast Cleaning

7.1 Remove visible dust and loose residues caused by dry abrasive blast cleaning.

7.2 If the surface was wet abrasive blast cleaned, rinse with fresh water to which enough corrosion inhibitor has been added to prevent rusting, or with fresh water followed by an inhibitive treatment approved by the coating manufacturer.

7.3 The blast cleaned surface shall be further treated or primed, as specified in the contract, preferably within 24 hours after blast cleaning, and before any visible or detrimental rusting occurs. Where chemical contamination of the surface may occur, the steel shall be painted as soon as possible after blast cleaning.

7.4 If any rust forms after blast cleaning, the surface must be reblast cleaned before coating. Note: Alternate repair methods, if agreed upon by the contracting parties, may be substituted.

8. Blast Cleaning Abrasives

8.1 The abrasive (sand, grit, or shot) must be dry and free of contaminants, oil, grease, or other harmful elements.

8.2 Selection of the abrasive size and type is based on the type of steel, grade of steel, surface condition of the steel, the finished surface to be produced, and the coating system to be used.

9. Inspection

9.1 Inspection of the surface shall be agreed upon by the contracting parties.

10. Safety Precautions

10.1 If fire or exposion hazards are present, proper precautions shall be taken before any work is done.

10.2 Approved helmets, respirators, and other protective gear shall be provided to all workers and others exposed to blast dust, flying objects, or paint spray environment.

10.3 Blast hose shall be grounded to dissipate static charges.

10.4 Safety procedures shall follow any applicable federal, state, and local rules as well as requirements of insurance underwriters.

Designation: D 2200 – 67
(Reapproved 1972)

American National Standard Z158.2-1969 (R1974)
Reaffirmed Aug. 12, 1974
By American National Standards Institute
Swedish Standards Association
Standard SIS 05 59 00
Steel Structures Painting Council
SSPC-Vis 1 - 67T
Danish Standards Association
Danish Standard DS 2019
European Committee of Paint and Printing
Ink Manufacturers' Association

Standard

PICTORIAL SURFACE PREPARATION STANDARDS FOR PAINTING STEEL SURFACES[1]

This Standard is issued under the fixed designation D 2200; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

The pictorial standards described herein were prepared by the Swedish Standards Inst. and have been jointly approved by the American Society for Testing and Materials, Steel Structures Painting Council, and the Swedish Standards Inst.

1. Scope

1.1 The pictorial surface preparation standards are available as a separate publication.[2] They consist of a series of color prints. The descriptive text accompanying the standards is printed in six languages: English, Swedish, German, Spanish, French, and Russian.

1.2 The pictorial surface preparation standards represent different conditions of ferrous surfaces prior to painting. The standards include four rust grades before cleaning, *A*, *B*, *C*, and *D*, which cover the range from intact mill scale to badly rusted and pitted steel. Also included are two types of cleaning, *St* and *Sa* (*St*—scraping and wire brushing, and *Sa*—blast cleaning), and four degrees of cleaning, 0 to 3 (0—no surface preparation, 1—light, 2—thorough, and 3—extreme scraping and wire brushing, that is, equivalent to power tool cleaning or blast cleaning to white metal).

1.3 The pictorial standards are reproduced in color and are intended for use in judging and evaluating the degree of cleaning of steel surfaces prior to painting.

2. Definitions

2.1 The applicable definitions appear in the text of the photographic reference standards publication.[2]

3. Procedure and Interpretation

3.1 Determine the degree of surface cleaning of the steel structure being evaluated by comparison with the color reference standards.

NOTE—Different steel surfaces will show differences in shade, color, tone, pitting, flaking, mill scale, etc. To some extent, these differences between the actual steel surface and the photographic standards can be reconciled between the painting contractor and the inspector.

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[1] These pictorial standards are under the jurisdiction of ASTM Committee D-1 on Paint, Varnish, Lacquer, and Related Products.

Current edition accepted Nov. 30, 1967. Originally issued 1966. Replaces D 2200 - 66.

The 1967 revision consists of the addition of new preparation grade C Sa 2½, Blast Cleaning ("Near White"), and improved photographs for grades B Sa 2 and C Sa 2, as prepared and proposed by the Swedish Standards Assn.

[2] The pictorial surface preparation standards are available from the American Society for Testing and Materials, 1916 Race St., Philadelphia, Pa. 19103; The Steel Structures Painting Council, 4400 Fifth Ave., Pittsburgh, Pa. 15213; and Sveriges Standardiseringskommission, Box 3295, Stockholm 3, Sweden. Request Adjunct No. 12-422000-00.

Steel Structures Painting Council

SURFACE PREPARATION SPECIFICATION NO, 1
Solvent Cleaning

1. Scope

1.1 This specification covers the requirements for the: solvent cleaning of steel surfaces.

2. Definition

2.1 Solvent cleaning is a method for removing all visl. ble oil, grease, soil, drawing and cutting compounds, and other soiuble contaminants from steel surfaces.

2.2 It is intended that soivent cleaning be used prior to the application of paint and in conjunction with surface preparation methods specified for the removal of rust, mill scale, or paint.

3. Surface Preparation Before and After Solvent Cleaning

3.1 Prior to solvent cleaning, remove foreign matter (other than grease and oil) by one or a combination of the following: brush with stiff fiber or wire brushes, abrade, scrape, or clean with solutions of appropriate cleaners, provided such cleaners are followed by a fresh water rinse.

3.2 After solvent cleaning, remove dirt, dust, and other contaminants from the surface prior to paint appli. cation. Acceptable methods include brushing, blow off with clean, dry air, or vacuum cieaning.

4. Methods of Solvent Cleaning

4.1 Remove heavy oil or grease first by scraper. Then remove the remaining oil or grease by any of the following methods:

4.1.1 Wipe or scrub the surface with rags or brushes wetted with solvent. Use clean solvent and clean rags or brushes for the final wiping.

4.1.2 Spray the surface with solvent. Use clean sol - vent for the final spraying.

4.1.3 Vapor degrease using stabilized chlorinated hydrocarbon solvents.

4.1.4 Immerse completely in a tank or tanks of solvent. For the !ast immersion, use solvent which does not contain detrimental amounts of contaminant.

4.1.5 Emulsion or alkaline cleaners may be used in place of the methods described. After treatment, wash the surface with fresh water or steam to remove detrimental residues.

4.1.6 Steam clean, using detergents or cleaners and follow by steam or fresh water wash to remove detrimental residues.

5. Inspection

5.1 All work and materials supplied under this specification shall be subject to timely inspection by the purchaser or his authorized representative. The contractor shall correct such work or replace such material as is found defective under this specification. In case of dispute the arbitration or settlement procedure established in the procurement documents, if any, shall be followed. if no arbitration or settlement procedure is established, the pro cedure specified by the American Arbitration Association shall be used.

5.2 The procurement documents covering work or purchase should establish the responsibility for testing and for any required affidavit certifying full compliance with the specification.

6. Safety

6.1 All safety requirements stated in this specification and its component parts apply in addition to any ap. pllcable federal, state, and local rules and requirements. They also shall be in accord with instructions and requre ments of insurance underwriters.

7. Notes

7.1 While every precaution is taken to insure that ail information furnished in SSPC specifications is as ac. curate, complete, and useful as posslble, the SSPC cannot assume responsibility or incur any obligation resulting from the use of any materials, paints, or methods specified therein, or of the specification itself.

7.2 A Commentary Section is avallable (Chapter 2 of Volume 2 of the Steel Structures Painting Manual) and contains additional information and data relative to this specl.fication. The Surface Preparation Commentary is not part of this specification. The table below lists the subjects discussed relevant to solvent cleaning and appropriate Commentary Section.

Subject	Commentary Section
Solvents and Cleaners	11.1 through 11.1.3
Steam Cleaning	11.1.4
Threshold Limit Values	11.1.5
FilmThickness	10.0

SECTION 5

Attachments

5. Attachment of Reviewed Standards

1) ASTM D 610-68 “Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces”
2) ASTM D 2200-67 “Standard Pictorial Surface Preparation Standards for Painting Steel Surfaces: (1974)
3) ASTM D 3276-80 “Standard Guide for Paint Inspectors” (1980)
4) BS 4232:1967 “British Standard Specification for Surface Finish of Blast-Cleaned Steel for Painting”
5) JSRA 1975 “Standard for the Preparation of Steel Surface Prior to Painting”
6) NACE Standard RP-01-72 “Surface Preparation of Steel and Other Hard Materials by Water Biasing Prior to Coating or Recoating”
7) SIS 05 59 00 - 1967 “Pictorial Surface Preparation Standards for Painting Steel Surfaces”
8) SNAME Technical & Research Bulletin No. 4-9 “Abrasive Blasting Guide for Aged or Coated Steel, Surfaces”
9) SSPC Vis 2-68T “Standard Methods of Evaluating Degree of Rusting on Painted Steel Surfaces”
10) SSPC SP 5/6/10-63, (1963)
11) SSPC SP 5/6/10-82, (1982)
12) SSPC “Surface Preparation Commentary”

Designation: D 610 – 68 (Reapproved 1974)

American National Standard Z158.3
American National Standards Institute
Steel Structures Painting Council
SSPC-Vis-2-68 T

Standard Method of EVALUATING DEGREE OF RUSTING ON PAINTED STEEL SURFACES[1]

This Standard is issued under the fixed designation D 610; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

This method has been jointly approved by the American Society for Testing and Materials and the Steel Structures Painting Council.

This method has been approved by the Department of Defense to replace Method 6451 of Federal Test Method Standard No. 141A and for listing in the DoD Index of Specifications and Standards. Proposed revisions should be coordinated with the Federal Government through the Army Materials and Mechanics Research Center, AMXMR-MS, Watertown, Mass. 02172.

1. Scope

1.1 The colored photographic reference standards[2] available for use with this method are representative of degrees of rusting on painted steel (or iron) surfaces. They are to be used for comparative purposes and are not intended to have a direct relationship to a decision regarding painting requirements. These standards were developed in cooperation with the Steel Structures Painting Council (SSPC) to further standardization of methods.

2. Type of Rusting

2.1 The colored photographic reference standards and the associated rust-grade scale cover only rusting not accompanied by blistering and evidenced by visible rust.

NOTE 1—Rust blistering beneath paint may be graded using the same scale by assuming the rust was completely visible and noting that the rusting was rust blistering.

3. Rust Grade Scale (Note 2)

NOTE 2—The linear, numerical rust grade scale is an exponential function of the area of rust so that slight amounts of first rusting have the greatest effect on lowering the rust grade; the rust grade versus area of rust is a straight line plot on a semilogarithmic plot from rust grade 10 to rust grade 4. The slope of the curve was changed at 10% of the area rusted to 100% rusted to permit inclusion of complete rusting on the 0 to 10 rust grade scale.

3.1 The scale and verbal description shown in Table I shall be used in conjunction with the photographic reference standards.

4. Use of Photographic Reference Standards (Note 3)

NOTE 3—The pictorial representations illustrated in Fig. 1 (taken from the Steel Structures Painting Manual, Vol 2) show examples of area percentages which may be helpful in rust grading.

4.1 The use of the photographic reference standards (available separately from ASTM or SSPC) requires the following precautions:

4.1.1 Some finishes are stained by rust. This staining must not be confused with the actual rusting involved.

4.1.2 Accumulated dirt or other material may make accurate determination of the degree of rusting difficult.

4.1.3 Certain types of deposited dirt that contain iron or iron compounds may cause surface discoloration that should not be mistaken for corrosion.

4.1.4 It must be realized that failure may vary over a given area and discretion must therefore be used in applying these reference standards.

4.1.5 In evaluating surfaces, consideration shall be given to the color of the finish coating, since failures will be more apparent on a finish that shows color contrast with rust, such as

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[1] This method is under the jurisdiction of ASTM Committee D-1 on Paint, Varnish, Lacquer, and Related Products.

Current edition approved Sept. 13, 1968. Originally issued 1941. Replaces D 610 – 43.

[2] The colored photographic reference standards are available at a nominal cost from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. 19103 (Request Adjunct No. 12-406100-00), and from the Steel Structures Painting Council, 4400 5th Ave., Pittsburgh, Pa. 15213.

used in these reference standards, than on a similar color, such as an iron oxide finish.

4.1.6 The photographic reference standards are not required for use of the rust-grade scale since the scale is based upon the percent of the area rusted and any method of assessing area rusted may be used to determine the rust grade.

TABLE 1 Scale and Description of Rust Grades

Rust Grades[a]	Description	ASTM-SSPC Photographic Standard
10	no rusting or less than 0.01% of surface rusted	unnecessary
9	minute rusting, less than 0.03% of surface rusted	No. 9
8[b]	few isolated rust spots, less than 0.1% of surface rusted	No. 8
7	less than 0.3% of surface rusted	none
6[c]	extensive rust spots but less than 1% of surface rusted	No. 6
5	rusting to the extent of 3% of surface rusted	none
4[d]	rusting to the extent of 10% of surface rusted	No. 4
3[e]	approximately one sixth of the surface rusted	none
2	approximately one third of the surface rusted	none
1	approximately one half of the surface rusted	none
0[f]	approximately 100% of surface rusted	unnecessary

[a] Correspond to Swedish Pictorial Standards for Rusting (1955) (black and white).
[b] Corresponds to SSPC Initial Surface Conditions E and BISRA (British Iron and Steel Research Assn.) 0.1%.
[c] Corresponds to SSPC Initial Surface Conditions F and BISRA 1.0%.
[d] Corresponds to SSPC Initial Surface Condition G.
[e] Rust grades below 4 are of no practical importance in grading performance of paints.
[f] Corresponds to SSPC Initial Surface Condition H.

Designation: D 2200-67
(Reapproved 1972)

American National Standard Z158.2-1969 (R1974)
Reaffirmed Aug. 12, 1974
By American National Standards Institute
Swedish Standards Association
Standard SIS 05 59 00
Steel Structures Painting Council
SSPC-Vis 1 - 67T
Danish Standards Association
Danish Standard DS 2019
European Committee of Paint and Printing
Ink Manufacturers' Association

Standard

PICTORIAL SURFACE PREPARATION STANDARDS FOR PAINTING STEEL SURFACES[1]

This Standard is issued under the fixed designation D 2200: the number immediately following the designation indicates the year of original adoption or. in the case of revision. thc year of last revision. A number in parentheses indicates thc year of last reapproval.

The pictorial standards described herein were prepared by the Swedish Standards Inst. and have been jointly approved by the . American Society for Tessting and Materials. Steel Structires Painting Council, and the Swedish Standards inst.

1. scope

1. 1 The pictorial surface preparation standards are available as a separate publication. * They consist of it series of color prints. The descriptive text accompanying the standards is printed in six languages: English, Swedish, Gcrman. Spanish. French. and Russian.

1.2 The pictorial surface preparation standards represent different conditions of ferrous surfaces prior to paintng. The standtards include four rust grades before cleaning. A, B. C, and D. which cover the range from intact mill scale to badly rusted and pitted steel. Also included are two types of cleaning, .St and Sa (St–scraping and wire brushing, and Sa–blast cleaning). and four degrees of cleaning. 0 to 3 (0–no surface preparation, l–light. 2–thorough. and 3–extreme scraping and wire brushing, that is, equivalent to power tool cleaning or blast cleaning to white metal).

1.3 The pictorial standards are reproduced in color and are intended for usc in judging and evaluating the degree of cleaning of steel surfaces prior to painting.

2. Definitions

2.1 The applicable definitions appear in the text of the photographic reference standards publication.

3. Procedure and Interpretation

3.1 Determine the degree of surface cleaning, of the steel structure being evaluated by comparison with the color reference standards.

Nom-Different steel surfaces will show differences in shade, color, tone, pitting, flaking, mill scale, etc. To some extent, these differences between the actual s!eel surface and the photographic standards can he reconciled between the painting contractor and the inspector.

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[1] These pictorial standards are under the jurisdiction of ASTM Committee D-1 on Paint. Varnish. Lacquer. and Related Products.

Currcnt cdition acceptcd Nov. 30.1967. Originally issued 1966. Replaces D 2200-66.

The 1967 revision consists of the addition of new preparation grade C Sa 2½. Blast Cleaning (."Near White."). and improved phonographs for grades B Sa 2 and C Sa 2, as prepared and proposed by the Swcdish Standards Assn.

* The pictorial surface prcparation standards arc available from the Amcrican Society for Testing and Materials. 1916 Race St.. Philadelphia. Pa. 19103: The Steel Struc. turcs Painting Council. 44.00 fifth Ave.. Pittsburgh. Pa. 15213: and Svcrigcs Standardisekommission. Box 3295. Stockholm 3. Sweden. Request Adjunct No. 12. 422000-00.

Designation: D 3276 – 80

AMERICAN SOCIETY FOR TESTING AND MATERIAS
1916 Race St., Phlladelphia, Pa. 19103
Reprinted from the Annual Beak of ASTM Standards, Copyright ASTM
If not Iisted In the current combined Index, will appear in the next edition.

Standard Guide for PAINT INSPECTORS'

This standard is issued under the fixed designation D 3276: the number immedia!ety following the designation indicates the year of original adoption or, in the case of revision. the year of last revision. A number in parentheses indicates the year of last reapproval.

3.4 Surface Preparation–General Discussion:

3.4.1 Surface preparation is one of the most important factors affecting the performance of paint. However, it must be pointed out that the cost of surface preparation should be balanced against the life obtained from a paint system and the most economical combination selected.

3.4.2 In order for the inspector to be familiar with the typical surface conditions found on structural steel, he should have available at all times pictorial standard on D 2200 or Steel Structures Painting Council SSPC-Vis-I. This visual and descriptive aid is useful for educational purposes and is invaluable as a reference when determining whether the degree of surface preparation specified in a contact has been attained. Frequently it is referenced in specifications. Steel Structures Painting Council also issues detailed surface preparation specifications covering methods from solvent cleaning and hand and power tool cleaning to various degrees of blast cleaning.

3.4.3 *Factors Affecting Coating Performance.*

3.4.3.1 *Cleanliness-Many* materials if left on the surface will affect the life of the coating. These include: residues of oil, grease, soil, weld spatter, and slag which weaken the adhesion or mechanical bond of the paint to the surface, or chemically attack the coatings: deposits of salts (such as chlorides and sulfates) or water which promote corrosion: rust, which shortens the life of the coating; and rust scale, which cannot bee protected by any coating and which cannot maintain adhesion to the steel.

3.4.3.2 *Mill Scale–Mill* scale can cause problems in proper preparation of the surface. Tight mill scale is a satisfactory surface to paint and, if it remained intact, would result in long paint life in mild or only moderately severe environments. However, it must be emphasized that the ordinary structure has little completely intact mill scale. Consequently, mill scale is a

constant source of trouble leading to failure of paint because it becomes cracked or loosened in shipping and in fabrication. As a result, corrosion of the bottom or ferrous oxide layer of the mill scale and the underlying metal develops. This corrosion is accelerated by the cathodic relationship of the outermost layer of mill scale to the steel. Upon weathering or upon exposure of the painted steel, patches of mill scale loosen or lift. rupturing the paint film. Rusting continues and may undercut the remaining sound paint.

3.4.3.3 *Surface Profile-The* roughness of the metal surface has a significant effect on the performance of coatings. If it is too smooth, there is little mechanical adhesion but if it is too rough, there is difficulty in obtaining adequate coating thickness because of the irregularities. Research conducted by the Steel Structures Painting Council has shown that anchor patterns or surface profiles produced by commercial grit blasting-may be as much as 10 roils (254 pm) in height between the bottom of valleys and tip of peaks. Obviously, it is difficult to protect such a surface with a coating of normal thickness. and rusting begins on the peaks. The anchor pattern adopted should be sufficiently deep to provide a good anchor, but shallow enough that the primer coat of paint adequately covers the peaks by at Icast 1 mil (25 pm) of dry paint. Note that when a dry paint thickness is specified, it represents that thickness required above the peaks of the profile. Hand or power wirebrushing as normally used does not result in rough surface anchors. Excessive power wirebrushing should be avoided because the anchor pattern will be eliminated and the surface polished to a glassy smoothness resulting in poor adhesion.

3.4.4 *Economics of Surface Preparation:*

3.4.4.1 Based on the above. the ideal metal surface for good performance is free of soil, grease, oil. chemical products, scale. and oxidation products, with a mechanical surface anchor of a height known to be suitable for the coating System employed. This "toothy'" surface will improve adhesion of the paint to the metal substrate.

3.4.4.2 For practical and economic reasons, the exact condition of this ideal surface may not be obtained. However. attempts can be made to come as close to this condition as the service and anticipated life of the structure economically permit, always bearing in mind the characteristics of the coating that must be applied. The degree of cleanliness needed for the coating in question must be obtained regardless of the methods used to reach this final condition. It may involve hand cleaning prior to blasting, or chemical cleaning prior to final blasting, or solvent cleaning prior to any of the methods. In other instances, a mechanical cleaning of the metal may precede final cleaning or treatment by chemical methods.

3.4.4.3 It maybe found that for the general steel structure exposed in mild environments. it is not economical to remove completely all rust and mill scale. Normally. removal of oil and grease, removal of all loose rust and Ioose mill scale by hand and power tools, and the application of primers with good.surface wetting properties and containing rust-inhibitive pigments will result in economical protection. Where the primer is one with very quick-drying properties or poor rust wetting characteristics. then thorough blast cleaning or pickling must be adopted. Sometimes an intermediate grade of cleaning, such as brush-off blast cleaning. or power-tool cleaning, may suffice, particularly if very careful work is done.

3.4.4.4 Blast cleaning to white metal is an expensive method and is usually reserved for very severe corrosive exposures where absolutely no rust. mill scale or foreign matter can be tolerated. Near white blasting sloes allow for retention of very minor amounts of rust stain, etc., which otherwise would be expensive to remove. This degree of cleaning is adequate for all but the most demanding conditions. Generally, commercial blast cleaning, which may leave slight stains, from rust and mill scale on the surface, is adequate preparation of the surface.

3.5 *Cleaning Procedures:*

3.5.1 Safety precautions are not addressed separately for each of the following cleaning methods. Each has its own safety-related hazards and OSHA regulations should be followed.

3.5.2 *Solvent Cleaning* is for the removal of oil, grease. soot, etc., by the usc of solvents. The solvent is applied to the surface by wiping or scrubbing with rags or brushes. The contaminants must be removed (not simply spread out) by a thorough wiping of the affected areas with cloths saturated with clean solvents. The same

areas must be wiped a second time with clean cloths on which clean solvents have been poured. Contaminated cloths must not be dipped into the clean solvents. Emulsions, cleaning compounds, steam cleaning, or similar materials and methods may also be used. Where emulsion cleaners, soaps, and detergents arc used they must be removed completely by washing with clean, hot water. Steel Structures Painting Council surface preparation specification SSPC-SPI covers cleaning procedures using these materials.

3.5.2.1 *Solvent Vapor* Cleaning–This procedure can be adopted to an automated production line or can be utilized with smaller piece work operations. Vapor cleaning removes all soluble contamination but dots not disturb the natural oxide film on the metal. It should be combined with a mechanical cleaning or abrasion if this film must be removed. The part to be cleaned is cooled to room temperature and placed in the saturated vapor zone above the boiling, stabilized, chlorinated solvent in a vapor phase-type degreaser until it reaches the temperature of the vapor, at which time condensation on the panels no longer occurs. Parts should be wiped to remove any insoluble soils. Vapor cleaning or decreasing has an advantage over solvent wiping in that hot solvents maybe used and the solvent condensation removes the soil from the surface without recontamination.

3.5.3 *Hand-Tool Cleaning* is the method used for the removal of loose mill scale, loose rust, loose or otherwise defective paint, weld flux, slag, and spatter from metal surfaces by hand brushing, hand sanding, hand chipping or hand scraping, using wire, fiber or bristle brushes, sandpaper, steel wool, hand scrapers, or hand chisels, and chipping hammers. The surface is then cleaned to the condition St 2 given in Method D 2200. SSPC also provides a detailed specification for hand-tool cleaning SSPC-SP2.

3.5.3.1 Hand-tool cleaning requires that all tar, oil, grease, grease-like contaminants weld flux, etc., should first be removed by solvent cleaning (SSPC-SPI).

3.5.3.2 Wire brushes should be of sufficient rigidity to clean the surface thoroughly and of the proper shape to penetrate into all corners; joints, etc. The brushes should be kept free of all materials that tend to clog or choke the brush wires. Hand scrapers should be made of tool steel, tempered and ground to a sharp edge and should be of the proper size and shape to enable cleaning to be done as spccified. Scrapers should be kept sharp and in an approved condition at all times.

3.5.4 *Power Tool Cleaning* is a method used for the removal of loose mill scale. loose rust. loose or otherwise defective paint. weld flux, slag, spatter, etc., from metal surfaces by power wirebrushes, power impact tools. power grinders, power sanders, or by a combination of these methods. This surface is cleaned to the condition St 3 given in Method D 2200. SSPC SP-3 is a detailed specification for power tool cleaning. Although this is the currently accepted definition for power tool cleaning, it should be emphasized that tools are available that remove all mill scale, rust. etc. It is not uncommon to use power tools to achieve a degree of cleanliness equivalent to a blast-cleaning specification although the profile will be different.

3.5.4.1 Power tool cleaning requires that all oil, grease, weld flux, etc., be first removed by solvent cleaning (SSPC-SP1).

3.5.4.2 Hand tool cleaning (SSPC-SP2) may also be used prior to power tool cleaning.

3.5.4.3 All equipment must be suitable for the configuration of the work and maintained free of material that clogs the wire or disks making them ineffective. All impact tools should be kept sharp.

3.5.5 *Blast Cleaning*

3.5.5.1 Blast cleaning is used to remove foreign materials from metal surfaces and to provide a roughened surface by means of a-dry sand grit, or shot blast. One method utilizes compressed air, special blast nozzles. and sharp, clean, dry sand, grit, or shot. In another method, centrifugal wheels propel the abrasives. Frequently the minimum and maximum particle size of the abrasive or the desired surface profile is specified. Occasionally a high pressure water blast with an abrasive injected into the stream is used as an alternative to open blasting.

3.5.5.2 Remove all tar, oil, grease, or grease-like contaminants on the surface by solvent cleaning. The compressed air used for blast cleaning should be freed from detrimentale amounts of condensed water or oil by adequate separators and traps.

3.5.5.3 Blast-cleaning operations should be

performed so that no damage is done to partially or entirely completed portions of the work. Blast cleaning should progress from the top toward the bottom of a structure and should only be carried on downwind from any recently painted areas. Dry-blast cleaning operations may not be conducted on surfaces that will be wet after blasting and before painting.

3.5.5.4 The degree of blast cleaning required should at least be equal to the appropriate SSPC surface preparation specification and applicable to pictorial standard outlined in Method D 2200 as follows

Preparation Grade	steel slructures Paint Council Specification	ASTM D 2200
Blast cleaning to white metal	SSPC.SP5	Sa3
BIast cleaning to near whiIe	SSPC.SP10	sa2va
Commercial blast cleaning	SSPC-SP6	Sa2
Brush.off blast cleaning	SSPC-SP7	Sal

3.5.5.5 Blast-cleaned surfaces must be examined for any traces of oil, grease. or smudges, and where present, the contaminants must be removed by solvent cleaning. Surfaces that have been dry blasted should-be brushed with clean brushes made of hair, bristle, or fiber, blown off with compressed air (from which detrimental oil and water have been removed). or cleaned by vacuum to eliminate any traces of blast products. dust. or dirt from the surface. and also to remove abrasives from pockets and corners.

3.5.5.6 Blast-cleaned surfaces should be further treated. primed or painted. as specified. on the same day they arc blasted (preferably within 8 h ***or in*** any event before any visible rerusting occurs. Blast clean any blast-cleaned surface not coated prior to rust formation again so that it will be coated while still in an acceptable condition.

3.6 *Cleaning and Preparation of Various Surfaces:*

3.6.1 Genera/—Before application of any paint, all surfaces to be coated must be thoroughly cleaned and properly prepared to the requirements of the specification. All dust, dirt, oil. grease moisture, smoke. soot. tars. bitumens,. or other contaminants should be removed from unpainted surfaces. Previously painted surfaces should be similarly cleaned of all such foreign matter and, in addition, all paint that has deteriorated to a chalky or powdered state or is checked, cracked, scaled, blistered. peeled. alligatored. wrinkled. sagged. loose. stained, or otherwise unacceptable should be removed. On metal surfaces all loose contaminates. shavings. should also be removed cuttings. from all parts of the structure. Mortar or cement drippings from construction or subsequent repairs or any other foreign materials should not be painted over but must be completely removed by suitable mechanical or chemical means. Any tree limbs or other growth overhanging or fouling the structure should be cut away-and removed. The cleanliness of all surfaces must be approved by the inspector before the application of any coat of paint.

3.6.2 *Steel:*

3.6.2.1 Removal of rust and scale must be done in the manner and to the degree specified. that is, hand tool. power tool, or blast cleaning.

3.6.2.2 On bridges. all dirt, debris. etc.. must be cleaned from around bearing plates. shoes. and so forth. The entire surface of the beam ***or*** truss scat on each unit of the structure should be cleaned. All trash, dirt. etc., should be removed from pockets and crevices of truss spans. All open steel grid-type decking should be cleaned by the usc of a detergent steam-water type jet that will clean painted-surfaces without softening or removing tightly adhering paint. After such cleaning, the surfaces should be washed with a clear water jet. The solution used should be that recommended by the manufacturer of the machine.

3.6.3 *Galvanized Surfaces* which are to be painted should be cleaned or allowed to weather a minimum of 6 months, after which they should be treated and prepared by one of the applicable methods in Recommended Practices D 2092. (Method A or D).

BRITISH STANDARD SPECIFICATION FOR

SURFACE FINISH OF BLAST-CLEANED STEEL FOR PAINTING

FOREWORD

This British Standard was prepred under the authority of the Pigments, Paints and Varnishes lndustry Standards Committee at the request of the British Association of Corrosion Engineers, now the lnstitute of Corrosion Technology. It is based on draft specifications for qualities of blast-cleaning proposed by an expert committee of the BACE, to whom due acknowledgement is made. It is not intended to cover wet methods of blast-cleaning.

The quality levels defined in this British Standard have been selected so as to be roughly equivalent to those defined in the internationally recognized standards of the Steel Structures Painting Council (USA) and the Swedish Standards Organization. This equivalence may be expressed as follows:

BS	SSPC	SIS 055900
First quality	White metal	SA 3
Second quality	Near-white	SA 2.5 (see Note)
Third quality	Commercial	SA 2

NOTE. The intermediate quality described here as SA 2.5 was not included in the 1960 edition of the Swedish Standard S1S 05 59 00. but was added to the fifth edition published in 1967.

This British Standard is concerned primarily with the quality of surface finish resulting from blast-cleaning and only secondarily with the blast-cleaning equipment and procedure required to produce these results. It has been found dificult to base the standard on detailed measurement and assessment of surface finish, but since the finish achieved is closely related to the type and grade of abrasive used. it has been decided to list the abrasives that will normally give the surface finishes specified, provided suitable equipment is used by cxperienced operators.

Some notes are also included on the use of this British Standard, under three headings:

Selection of a suitable quality of surface finish for a given purpose (see Clause 4).

Methods of control and inspection of the quality of surface. finish obtained (see Clause 5).

Blast-cleaning procedure (see Appendix A).

The blast-cleaning and protective painting of structural steelwork is considerd in detail in CP 2008".

This British Standard is concerned only with the preparation of steel surfaces for painting and not with the preparation requirements specified in BS 2569t, although the same surface finish may be suitable for metal spraying and for some types of paint.

Consideration was given to including a fourth quality equivalent to the so-called 'brush-off' finish that is sometimes used where the site or service conditions are not considered to justify (or do not permit) a better quality of finish. It was strongly felt, however, that this type of finish should not be encouraged or recommended as suitable for painting, and it was therefore decided to omit it from the standard.

SPECIFICATION

1. SCOPE

This British Standard specifics qualities of surface finish for all steels that are prepared by dry methods of blast-cleaning for the application of paints and non-metallic coatings. It applies both to uncoated steel, whether new or weathered, and to steel from which an old protective coating has to be removed.

First, second and third qualities of surface finish arc defined. Recommendations are made regarding the selection of an appropriate quality of surface finish for a particular paint system or purpose; methods of inspection and control of the surface finish achieved; and blast-cleaning procedures.

2. QUALITIES OF SURFACE FINISH

2.1 General. The quality of blast-cleaned steel surface is defined in terms of (1) cleanliness and (2) roughness. There arc no simple precise means of measuring these characteristics but the first can be estimated from the appearance of the surface and the second can generally be controlled within broad limits by the choice of blast-cleaning procedurc, and notably Of the type and grade of abrasive.

The surface finish attainable depends to a large extent upon the condition of the steel before blast-cleaning and a first quality finish is unlikely to be attained if the steel is decply pitted or otherwise severely corroded before blast-cleaning, even though all contaminants appear to have been removed. Further, the degree of corrosion that has occurred before blast-cleaning (**as** indicated, for example, in the Swedish Standard S1S 05 59 00) may be reflected in the ultimate performance of the painted steel; the greater- the degree of corrosion before cleaning, the more difficult it is to remove all surface contaminants and if this is not done the durability of the paint coating will be decreased.

l CP 2008, 'Protection of iron and steel structures *from* corrosion '.
f BS 2569, ' Sprayed metal coatings '.

2.2 Surface cleanliness. The following levels of cleanliness are covered by this British Standard (see also Table 1).

(1) *First quality.* The entire surface shall show blast-cleaning pattern and shall be clean bare steel completely free from any contamination or discoloration.

Areas that appear shadowed solely because of differences in the blast-cleaning pattern or the structure of the steel shall be classed as clean steel.

(2) *Second quality.* The entire surface shall show blast-cleaning pattern and shall be cornpletely free from contamination by oil, grease, dirt or other matter, except that tightly-bonded residues of rnillscale or rust shall be permissible up to the following limits:

For the whole surface. An average of not more than 5% i.e. at least 95% of the surface shall be clean bare steel.

For any single squre of 25 mm (1 in) side. Not more than 10%; i.e. at least 90 % of the square shall be clean bare steel.

Areas that appear shadowed solely because of differences in the blast-cleaning pattern or the structure of the steel shall be classed as clean steel.

(3) *Third quality.* The entire surface shall show blast-cleaning pattern and shall be completely free from contamination by oil, grease, dirt or other matter, except that tightly-bonded residues of millscale, rust, paint or other previous coating shall be permissible up to the following Iimits:

***For the whole surface.* An average of not more than 20%; i.e. at least 80% of the surface shall be clean bare steel.**

***For any single square of 25 mm (1 in) side.* Not more than 40%; i.e. at least 60% of the square shall be clean bare steel.**

NOTE:. large 1 and 2 are included as diagrammatic indications of the amounts of fine and coarse nullscale residues that would satisfy the above detinitions of second and third quality finishes. respectively. These diagrams are not intended to represent the actual appearance of the blast-cleaned steel surface, which may vary considerably (for the same quality of finish) according to !he type of steel, the method of manufacture, the condition of the surface before cleaning, the type and grade of abrasive, and the blast-cleaning procedure adopted.

2.3 Surface roughness

2.3.1 *General.* The surface roughness achieved for each of the qualities of finish depends mainly upon the type of steel, its condition before blast-cleaning and the type and grade of abrasive used (see Clause 3).

2.3.2. *Use of metalic abrasives.* The grades of metalic abrasive recommended have been selected with the target of a surface roughness defined by a maximum amplitude" of 0.10 mm (0.004 in), which is usually acceptable for painting.

• The term maximum amplitude as used in this BritishStandard is defined as the greatest vertical distance between the summit of any peak on the blast-cteaned surface and the bottom of an immediately adjucent trough. but without taking into account any exceptionally high rogue peaks", which are liable to occur on a blast-cleaned surface as a result of embedded particles of abrasive. Such peaks are very undesirable and their size and number maybe the subject of special agreement between the parties to a contract.

TABLE 1. QUALITIES OF SURFACE FINISH OF BLAST-CLEANED STEEL , FOR PAINTING

Quality of surface finish	First quality	Second quality	Third quality
Types Of steel	All steels, including structural steels to BS 15, BS 968 and BS 2762′		
General appearance	Whole surface to show blast-cleaning pattern		
Discription of finish:			
Clean bare steel	Whole surface	At least 95% Of surface	At least 80% Of surface
Extent of residue	Nil	Not more than 10% of any single square of 25 mm (1 in) side	Not more than 40% of any single square of 25 mm (1 in) side
Type of residue permitted:			
MiIIscale	Nil	Tightly-bonded residues	Tightly-bonded residues
Rust	Nil		
Paint or other coating	Nil	Nil	
Loose abrasive and dust	Nil	Nil	Nil
Surface roughness	The maximum amplitude should be related to the paint system and should preferably not exceed 0“10 mm (0.004 in) (sec 2.3)		

•BS 15. ‘ Mild steel for general structural purposes ‘.
BS 968, ‘ High yield stress (welding quality) structural sleel ‘.
BS 2762, ‘ ,Notch ductile steel for general structural purposes .

2.3.3 *Use of non-metallic abrasives.* Similarly, the grades of non-metallic abrasive recommended have been selected with the target of a surface roughnesse defined by a maximum amplitude of 0.18 mm (0.007 in). If a maximum amplitude of 0.1 mm (0.004 in) is required, this can be obtained by using abrasive of maximum particle size 1 mm (0.04in), i.e. No. 16 mesh.

2.3.4 *Rusty steel.* When rusty steel is cleaned, whether metallic or non-metallic abrasives are used, the surface roughness attainable will be influenced by the condition of the steel and this shall be taken into account when assessing the maximum amplitude of the cleaned surface.

2.3.5 *Methods of measurement.* No completely satisfactory method of measuring surface roughness is available for use in the field. It is advisable for the parties to a contract to agree beforehand on the method to be used, e.g. in case of dispute, and the following are examples of methods that may be suitable*.

(1) *Sectioning.* A metallurgical section is prepared and the surface profile measured under a suitable microscope using a micrometer eyepiece.

(2) *Grinding.* The thickness of the blast-cleaned specimen is measured with a flat-ended micrometer. The surface is then ground until the bottoms of only the deepest pits are just visible. A further thickness measurement is then taken.

(3) *Direct measurement by microscope.* The blast-cleaned specimen, or replica, is viewed through a suitable microscope, first focussing on the peak and then focussing on the lowest adjacent trough, noting the necessary adjustment of focus.

(4) *Profile tracing.* A blast-cleaned specimen is traversed with a diamond or sapphire stylus and the displacement of the stylus as it passes over peaks and troughs is recorded.

3. ABRASIVES

It is desirable to specify by agreement between the parties, the types and grades of abrasive and method of use. The types and grades of abrasive listed in Table 2 are, in general, the coarsest for producing the qualities of surface finish covered by this British Standard (see also 2.3). Unless specifically agreed otherwise, these or finer grades should be used.

* A review of the present position is given in Chandler, K. A. and Shak, B. J., 'The assessment of surface profile after blast-cleaning', British Corrosion Journal, 1966, 1, No. 8 (Sept.), 307-316.

TABLE 2. TYPES AND GRADES OF ABRASIVE

	Mesh	Per cent by weight passing sieve									
	No.	6	8	12	14	16	18	25	30	44	60
	mm	2·80	2·00	1·40	1·20	1·00	0·850	0·600	0·500	0·355	0·250
	in	0·1102	0·0787	0·0551	0·0472	0·0394	0·0335	0·0236	0·0197	0·0140	0·0098
S 240	chilled iron shot	—	—	—	—	100	90 min.	15 max.	—	Nil	—
S 340	steel and malleable iron shot	—	—	100	95 min.	—	15 max.	—	Nil	—	—
G 24	chilled iron grit	—	—	—	—	100	—	15 max.	—	Nil	—
G 39	steel and malleable iron grit	—	—	100	—	15 max.	—	Nil	—	—	—
Non-metallic abrasive		100	80 min.	—	—	—	—	—	—	—	5 max.

NOTE 1. If mixtures of shot and grit are used, both components should comply with these requirements.
NOTE 2. Size grades for blast-cleaning with sand are not included. If this abrasive is used, special precautions are necessary in view of the health hazard involved.
NOTE 3. The sieve sizes are those specified in BS 410, ' Test-sieves ', and the grading of the shot and grit is in accordance with BS 2451, ' Chilled iron shot and grit '. The same sieve sizes are assumed for steel and malleable iron as for chilled iron.

4. SELECTION OF A SUITABLE QUALITY OF SURFACE FINISH

The quality of surface finish to be selected for particular circumstances depends, among other things, on the blast-cleaning procedure and the paint system necessary to protect the steel in the environment in which it is going to be used. Some guiding principles are stated in Table 3.

TABLE 3.

Quality	Typical application
First quality finish	For treating steelwork where extremely clean surfaces can be expected to prolong the life of chemical-resistant paint systems in exacting conditions
Second quality finish	The minimum requirement for chemically resistant paint systems such as epoxide and vinyl resin paints; also where the best attainable performance is required from conventional paint systems used under fairly corrosive conditions
Third quality finish	For steel that is to be painted with conventional paints for exposure to mildly corrosive atmospheric conditions

5. CONTROL AND INSPECTION

Methods of controlling the quality of surface finish, both with regard to cleaness and roughness; are in course of development. For the time being. some measure of control can be cxercised by comparison with agreed reference panels prepared beforchand to show the type of finish required. The following procedures have been found useful:

(1) In the case of large structures, it may be convenient to take coupon samples for inspection in the following manner:

A sample piece at least 150 mm .x 100 mm made from the metal identical to the base structure being treated and in the same surface condition, is held temporarily in position on the base. An area containing the sample piece. is then blast-cleaned to the desired finish. The sample piece is detached and plaecd in a clean. dry, airtight container containing sufficient moisture-absorbent material such as silica gel to dry the air in the container, for later examination in the laboratory or for reference purposes.

(2) Pholographs, such as those issued by the Swedish Standards Committee (S1S 055900. 'Rust grades for steel surfaces and proparation grades prior to protcclive coating"). are useful for assessing cleanliness.

(3) Sets of specially prepared reference plates" can be used to estimate roughness.

• For example. the Rugotest series.

APPENDIX A

BLAST-CLEANING PROCEDURE

A.1 The steel to be blast-cleaned should be dry and the operating conditions should be such that condensation dots not occur on it during the work. When compressed air is used, this should be dry and free from oil.

Any oil or grease should be removed from the steel surface before blast. cleaning is begun.

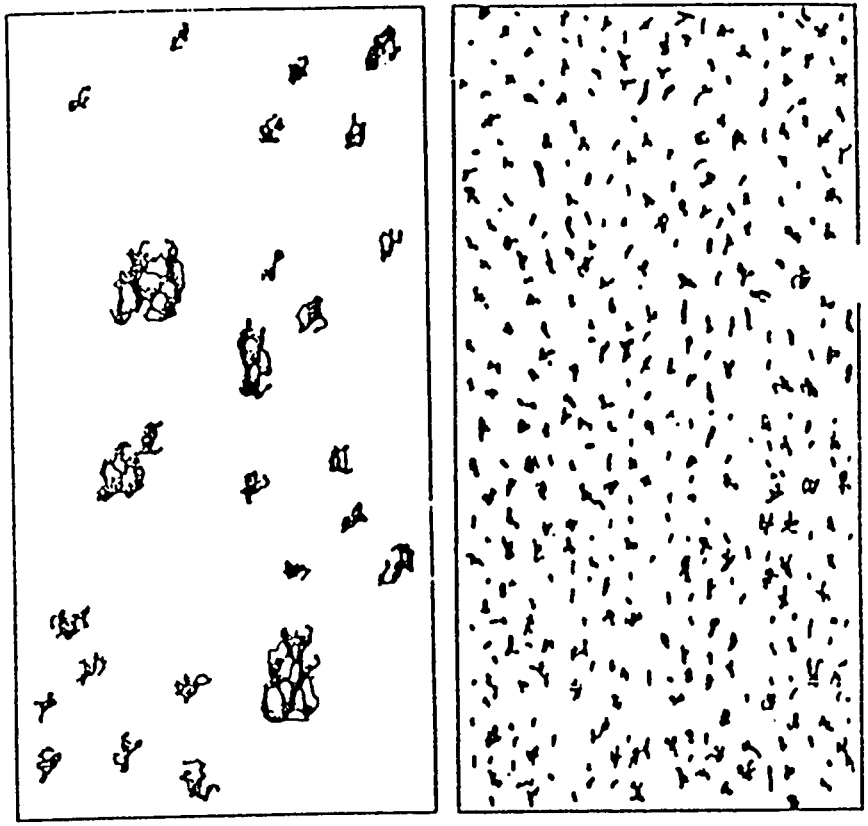
If the steel is heavily rusted, particularly if scaly rust is present, a preliminary cleaning with power-driven impact tools will generally prove onomical.

Unless an instantaneous-recovery blasting machine is employed, the cleaned surface should be air-blasted, vacuum-cleaned, or otherwise freed from abrasive residues and dust immediately after the blast-cleaning.

Following the removal of abrasive material, the surface should preferably be rubbed over briefly with a nylon scraper or scourer to rcduce the number of ' rogue peaks' (see footnote to 2.3.2).

The application of at least the first coat of paint or non-rnetallic coating should follow with the least possible delay and in any case before visible deterioration has occurred as compared with a freshly blast-cleaned area.

WHOLE SURFACE
(5% Millscale residues)



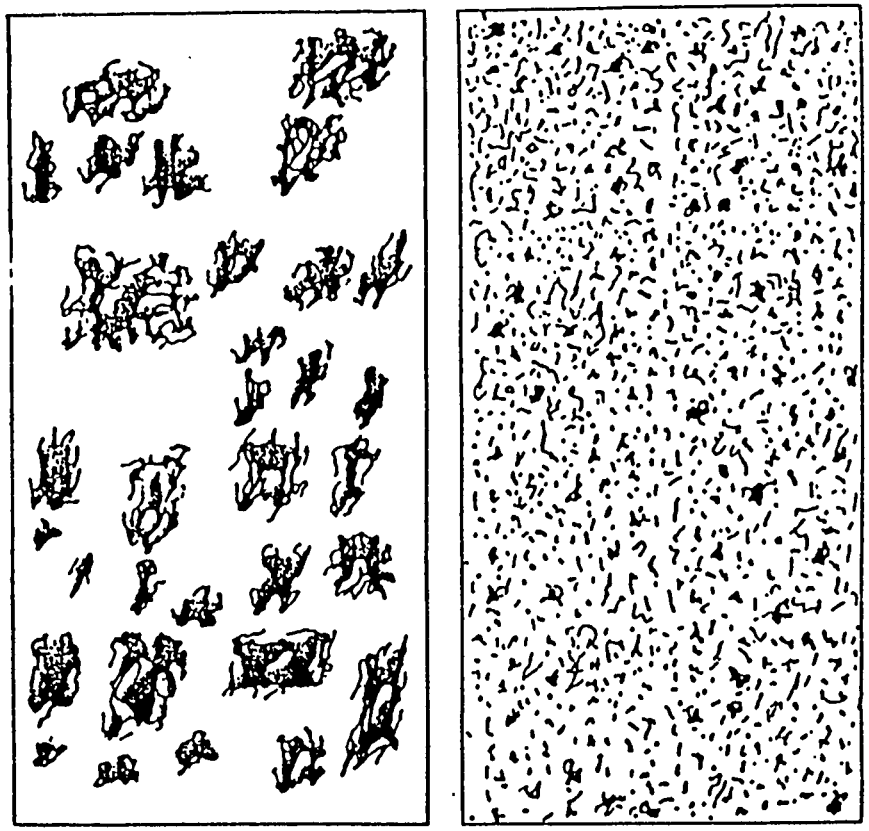
Coarse Fine

MAXIMUM PERMITTED IN ANY SINGLE 25 mm × 25 mm (1 in × 1 in)
(10% Millscale residues)

Coarse Medium Fine

Fig. 1. Diagrammatic indications of second quality

WHOLE SURFACE
(20% Millscale residues)



Coarse Fine

MAXIMUM PERMITTED IN ANY SINGLE 25 mm × 25 mm (1 in × 1 in)
(40% Millscale residues)

Coarse Medium Fine

Fig. 2. Diagrammatic indications of third quality

Standard for the Preparation of Steel Surface prior to Painting

PREFACE

The effective life of a coating of anti-corrosive paint applied to a steel surface is to a very large extent dependent on how thoroughly-the surface has been prepared prior to painting, in addition to painted film thickness.

Surface preparation consists of primary surface preparation which aims to remove mill scale, rust and foreign matter from steel surface prior to application of a shop primer and of secondary surface preparation which aims to remove rust and foreign matter, if any, from steel surface coated with a shop primer prior to application of an anti-corrosive paint.

As the standards of the primary surface preparation, s IS 05 59 00, SSPC- Vis 1 and etc. are generally used.

It is also important to establish a systematic standardization of the secondary surface preparation prior to protective painting at this time when shop primer painting is so widely applied in the process of hull construction. This Standard has been prepared by the 139th Research Section of the Shipbuilding Research Association of Japan.

SCOPE

As primary surface preparation this Standard refers to:

surfaces of hot-rolled steel in two different rusted grades (JA, JB)

the same surfaces prepared to three grades of surface quality (Sh1. Sh2, Sh3) by shot-blasting

the same surfaces prepared to three grades of surfacc quality (Sdl. Sd2. Sd3) by sand-blasting

the same surfaces in two different rusted grades (sh0, Sdo)prior to shot-blasting and Sand-blasting

As secondary surface preparation this Standard refers to:

surfaces of steel coated with each of shop primers (wash primer: W, organic zinc primer: Z, inorganic zinc primer: 1) after the primary surface preparation in ‘five different rusted/damaged grades (HO, AO, FO, DO, RO) due to welding, burning, weathering, etc.

the same surfaces prepared to three grades of surface quality (ss, Sd2, Sd3) by sand-blasting

the same surfaces prepared to three grades of surface quality (Pt1, Pt2, Pt3) by power tool

As treatment methods for secondary surface preparation this Standard refers to:

sand-blast cleaning for preparation grades (Sd2, Sd3)

sweep sand-blast cleaning for preparation grade (Ss)

disc-sander cleaning for preparation grades (FPt 1, FPt2, FPt3, DPt3)

wire-brushing/disc-sander cleaning for preparation grades (HPt2, H Pt3, ‘A Pt3)

wire-brushing cleaning for other prcporation grades by power tool

The standardized rust and preparation grades are defined by colour prints and their arrangement are as follows.

1. Conditions of Steel Surface prior to Surface Preparation

		Page
JA	JB	1

2 Grades of Primary Surface Preparation

				Pages
JA Sh0	JAShl	JA Sh2	JA Sh3	2-3
JB Sh0	JB Shl	JB Sh2	JB Sh3	4-5
JA Sd0	JASdl	JA Sd2	JA Sd3	6-7
JB Sd0	JBSdl	JB Sd2	JB Sd3	8-9

3. Conditions of Steel Surface Coated with Shop Primer

			Pages
Wo	**Zo**	**10**	10-11

4. Grades of Secondary Surface Preparation

					Pages
WO	WH0	WHPtl	WHPt2	WHPt3 WHSd2	12-14
WO	WA0	WAPtl	WAPt2	WAPt3 WASd2	150-17
WO	WF0	WFPtl	WFPt2	WFPt3 WFSd2	18-20
WO	WR0	WRPtl	WRPt2	WRSs	21-23
ZO	ZH0	ZHPtl	ZHPt2	ZHPt3 ZHSd2	24-26
ZO	ZA.0	ZAPtl	ZAPt2	ZAPt3 ZASd2	27-29
ZO	ZF0	ZFPtl	ZFPt2	ZFPt3 ZFSd2	30-32
ZO	ZD.0	ZDPtl	ZDPt2	ZDSs	33-35
ZO	ZR0	ZRPtl	ZRPt2	ZRSs	36-38
IO	lH0		I HPt3	I HSd3	39-40
IO	IA0		IAPt3	IASd3	41-42
IO	IF0		IFPt3	IFSd3	43-44
IO	ID0	I DPt3	I DSs	I .DSd3	45-47
IO	IR0		IRSs		48-49

JA	Steel covered with mill scale
JB	JA steel exposed to weather one and half months
Sh	Shot blast cleaning
Sd	Sand blast cleaning
w	Wash primer
z	Organic zinc primer
1	Inorganic zinc primer
11	Shop primed steel surface in way of hand welding
A	Shop primed steel surface in way of automatic welding
F	Shop primed steel surface in way of gas burning
D	Shop primed steel surface having white zinc salt
R	Shop primed steel surface having rust in the form of spots
Pt	Power tool cleaning
Ss	Sweep sand blast cleaning
0	Non surface preparation
1	Surface preparation of low grade
2	Surface preparation of middle grade
3	Surface preparation of high grade

Conditions of Steel Surface prior to Surface Preparation

JA : Steel surface covered with mill scale. (rarely with a little rust)

JB : JA steel surface exposed to weather one and half months. (The surface is covered with red rust, but there remains mill scale without pitting underneath the red rust.)

Grades of Primary Surface Preparation

Sh0 : Surface prior to blast cleaning of steel shots

Sh1 : Surface prepared by light blast cleaning of steel shots. Loose mill scale, rust and foreign matter are fairly removed.

Sh2 : Surface prepared by thorough blast cleaning of steel shots. Almost mill scale, rust and foreign matter are fairly removed.

Sh3 : Surface prepared by very thorough blast cleaning of steel shots. Mill scale, rust and foreign matter are removed to the extent that the surface has an uniform metallic sheen.

Sd0 : Surface prior to blast cleaning of slug sands **or** grits

Sdl : Surface prepared by light blast cleaning of slug sands or grits. Loose mill scale, rust and foreign matter are fairly removed.

Sd2 : Surface prepared by thorough blast cleaning of slug sands or grits. Almost mill scale, rust and foreign matter are fairly removed.

Sd3 : Surface prepared by very thorough blast cleaning of slug sands or grits. Mill scale, rust and foreign matter are removed to the extent that the surface has an uniform metallic sheen.

Conditions of Steel Surface Coated with Shop Primer

wo : Surface coated with shop primer (w) on JASh12

Zo : Surface coated with shop primer (z) on JASh12

10: Surface coated with shop primer (I) on JASh2

Conditions of Steel Surface prior to Secondary Surface Preparation

HO : Steel surface coated with shop primer (w, z, I)which is exposed to weather about one and half months after hand welding

AO : Steel surface coated with shop primer (w, z, I) which is exposed to weather about one and half months after automatic welding

FO : Steel surface coated with shop primer (W, Z, I)which is exposed to weather after gas burning and water cooling for removing strain of the steel

Do : Steel surface coated with shop primer (Z, I) on which white zinc salt is generated

RO Steel surface coated with shop primer (W, Z,I) on which little rusts in the form of spots are visible because of exposure to weather

Grades of Secondary Surface Preparation

Ptl : Surface prepared by wire-brushing for the surface conditions (H, A, D, R) and by disc-sander for' the surface condition (F). Loose rust and foreign matter are fairly removed.

Pt2 : Surface prepared by wire-brushing for the surface conditions (A, D, R), by wire-brushing and disc-sander for the surface condition (H), and by disc-sander for the surface condition (F). Almost all rust and foreign matter are fairly removed.

Pt3 : Surface prepared by wire-brushing and disc-sander for the surface conditions '(H ,A) and by disc-sander for the surface condition (F). Rust and foreign matter are removed to the extent that the surface has an uniform metallic sheen.

Ss : Surface prepared by light blast cleaning of slug sands or grits. (Shop primer with the little trace of rust is noticeable.)

Sd2 ; Same surface as the grade (Sd2) of the primary surface preparation.

Sd3 : Same surface as the grade (Sd3) of the primary surface preparation.

NACE Standard RP-01-72.

Recommended Practice

Surface Preparation of Steel and Other Hard Materials by Water Blasting Prior to Coating or Recoating

Section 1: General

1.1 Water blasting is particularly well suited as a means of **accomplishing heavy duty cleaning of steel and other hard** surfaces in instances when sandblasting is not feasible.

1.2 Because water blasting has no abrasive effect on steel or other hard surfaces and does not provide an anchor pattern for coating adhesion, its use is recommended primarily in maintenance painting programs.

1.2.1 If more thorough cleaning is desired, sand can be introduced into the water stream to give water-sandblasting.

1.3 Water blasting usually will remove anything that is not tightly adhered to the surface and is an effective technique for cleaning irregularly shaped surfaces such as valves, flanges, pumps, back.to.back angles, grating, and raised-pattern floor plate.

1.3.1 Water blasting has proved to be successful in the following operations:

(a) Removing surface chemical contaminants.
(b) Removing deteriorated and loose chalking paint.
(c) Removing poorly adhered paint.
(d) Removing loose rust and scale, with only a minimum of follow up wire brushing required.
(e) Removing concrete and gunite spatters from steel.
(f) Removing grease accumulations.
(g) Removing oil.
(h) Removing asphalt mastics and coal tar coatings.

1.3.2 Average time factors for water blast cleaning of coated and uncoated steel surfaces are shown in Tables 1 and 2.

1.3.3 A minimum of hand or power wire brushing may occasionally be necessary on rusted areas that have been exposed for some time after water blasting.

1.4 Manufacturers of paints and protective coatings should be consulted regarding the suitability of their products applied over water-blast-cleaned surfaces.

Section 2: Equipment

2.1 The commercial water blast unit is a trailer-mounted, high pressure pump driven by gasoline, diesel, electric or air motors or engines.

2.1.1 In addition to the power unit and pump, the unit includes a water filter, pressure gauge, hydraulic hose, and nozzle.

2.1.2 The unit can be operated at pressures up to 10,000 psi (Section 3.1) using a hydraulic hose with an inside diameter of 3/8 or 1/2 inch.

2,1,3 A water flow rate of 4 to 14 gallons per minute is required.

2.1.4 Hose lengths to several hundred feet can be used since only a negligible pressure drop occurs over these lengths.

2.1.5 Interchangeable nozzle tips can be used to produce a round or flat stream.

Section 3: Operating and Safety Procedures

3.1 Although a water blast machine will produce a concen. trated stream of water through a hose and nozzle at pressures of 2000 to 10,000 psi, experience shows the most practical pressure for surface preparation cleaning to be 2500 to 5000 psi. The volume of water is between 4 and 14 gpm. Pressures above 5000 psi constitute a hazard because they are difficult to handle and put undue stress and strain on the operator.

3.1.1 Water blasting can be destructive to nonmetallic surfaces. Soft wood, insulation, electric installations, and instrumentation must be protected from direct blasting and from indirect water stream.

3.2 Water used in water blasting units must be clean and free of erosive silts or other contaminants that damage pump valves and/or leave corrosive deposits on the surface being cleaned.

3.2.1 Detergents or various other types of cleaners may be used in conjunction with water blasting although many of these detergents must be removed from surfaces before applying a coating. It may therefore prove more economical to spray the detergent onto the surface before water blasting.

3.2.2 Rust inhibitors may be injected at the nozzle or at the water supply to prevent oxidation of bare metal.

3.3 Water blasting techniques are similar to those of sandblasting.

3.3.1 The nozzle is normally held six to ten inches from the surface which is being cleaned although in some instances, a distance of two or three feet may achieve the desired cleaning.

3.3.1.1 To remove heavy rust scale, greater impact can be obtained at a distance of two inches, and the work can be performed faster.

3.3.2 Angle of the nozzle is determined by the type of matter to be removed.

3.3.2.1 For the removal of brittle substances,

such as dead paint or rust scale, the nozzle normally is held almost perpendicular to the surface.

3.3.2.2 To remove heavy mastics, the angle should be 45 degrees or more to help peel the mastic away from the surface.

3.4 Safely procedures must be observed to prevent serious injury not only to the operator, but also to other persons within a 15.foot range of the nozzle.

3..4.1 A dead.man control valve should be used to protect the operator and anyone within range of work. A good type of valve releases the high pressure immediately by allowing the water to bypass through a half-inch opening when the trigger is released.

3.4.2 Operators should wear a face shield, rain suit, and gloves and must have firm footing when using the water blaster. When swinging scaffolds, bosun chairs, and similar riggings are used, the platform should be stabilized.

3.4.3 Normally there is no need for an attendant at the unit because it runs relatively trouble-free.

TABLE 1- Range of Time Required to Water Blast Uncoated Steel* (Square Feet Per Hour)

Structural Classification	Conditions 1	2	3	4	5	6	7
A	300.500	175.350	150-300	100.200	75.150	200.400	75.150
B	450-600	325.450	275-400	150-300	100.225	350-500	100-225
C	500.800	375.625	300.525	200.450	125-375	400.700	125.375
D	600.800	450-725	400.600	250.550	150.450	500-800	150.450
E	150.400	90-275	80-250	50-150	25-100	200.400	75-150

Structural Classification of Fabricated Items Including Structural Steel and Piping

A - Small size members having less than 1 square foot per lineal foot,
B- Medium size members having 1.3 square feet per lineal foot.
C - Members having greater than 3 square feet per Iineal foot.
D - Flat surfaces such as vessels, tanks, checker plate, floors, and undersides of floor plates. etc.
E - Gratings .

Surface Condition

1. Mud and loose foreign matter (Note: waterblasting will not remove adherent mill scale).
2. 10% of surface covered with rust, loose scale, and loose foreign, matter.
3. 30% of surface covered with rust, loose scale, and loose foreign matter.
4. 60% of surface covered with tightly adhering hard rust and pitting.
5. Greater than 60% of surface covered with tightly adhering rust and pitting.
6. Very light coating of oil and grease. No corrosion present.

Note: If corrosion exists on 6 and 7 (under the oil and grease). classify by the appropriate condition 2 through 5 above.

•All data are based on actual experience. The production was less in some isolated cases and greater in others. General conditions. environment, accessibility to work area, personnel protection. and equipment protection requirements will exert some influence on the time required.

TABLE 2- Range of Time Required to Water Blast Coated Steel* (Square Feet Per Hour)

Structural Classification	Conditions 1	2	3	4	5	6	7	8
A	200-400	175-350	150.300	l00.200)	75-150	200.400	75.150	5.25
B	350.500	325-450	275.400	150.300	100-325	350.500	100.225	5.30
C	400.700	375.625	300.525	200.450	125.375	400-700	125.375	10.30
D	500-800	450.725	400.600	350.550	150-450	500.800	150-450	12.40
E	100.300	90-275	80-250	50.150	25.100	200-400	75.150	5-25

Structural Classification of Fabricated terns Including Structural Steel and Piping

A - Small size members having less than 1 square foot per lineal foot.
B - Medium size members having 1.3 square feet per lineal foot,
C - Members having greater than 3 square feet per lineal foot.
D - Flat surfaces such as vessels, tanks, checker plate, floors, and undersides of floor plates, etc.
E - Gratings.

Surface Condition

1. Finish coat of paint weathered thin; paint has chalked; a very minor amount of contaminants and other foreign matter present: and no corrosion of substrate.
2. Finish coat of paint weathered thin and some primer showing. 10% of surface covered with rust, loose scale, and loose paint film.
3. Finish coat of paint thoroughly weathered. and considerable primer shows. Approximately 30% of surface covered with paint, rust, and corrosion scale. Some surface pitting and paint blistering.
4. Finish coat of paint thoroughly weathered with almost all primer showing. Approximately 60% of surface covered with tightly adhering rust. Some surface pitting and paint blistering.
5. Finish coat of paint and most primer completely worn off. Most of surface covered with hard rust and pitting.
6. Very light coating of oil and grease.
7. Heavy coating of oil and grease.
8. Asphalt mastic and coal tar coatings to be removed between 1/32 and 1/4 inch thickness.

•All data are hosed on actual experience. The production was Iess in some isolated cases and greater in others. General conditions. environment, accessibility to work area. personnel protection. and equipment protection requirements will clerl some influence on the time required.

SIS 05 59 00 - 1967 "Pictorial Surface Preparation Standards for Painting Steel Surfaces"

Scope

This Standard refers to

surfaces of hot.rolled steel in four different rust grades (A, B, C and D)

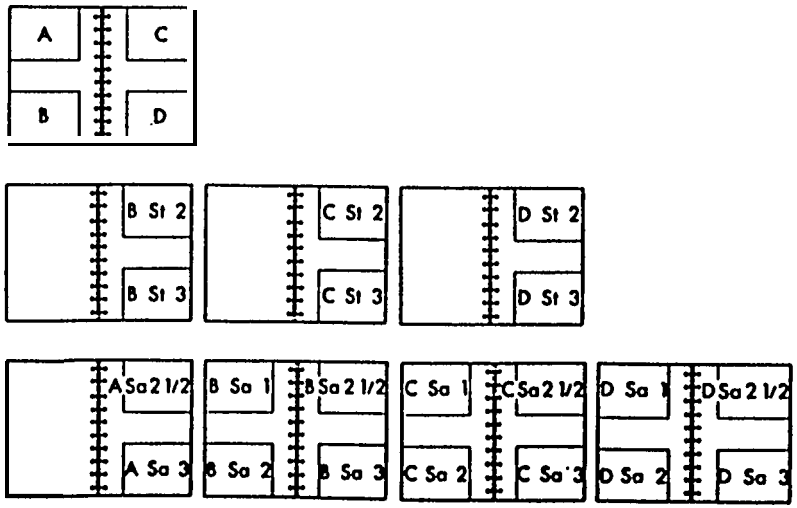
the same surfaces prepared to two grades of surface quality (St 2 and St3) by manual Scraping and wire-brushing –machine brushing – grinding – etc.

the same surfaces prepared to four grades of surface quality (Sa 1, Sa 2, Sa 21/2 and Sa 3) by blasting with various abrasives.

Examples: A steel surface originally corresponding to rust grade B,which has been scraped or brushed to preparation grade 2 is de. signated BSt2.
A steel surface originally corresponding to rust grade B, which has been prepared by blast cleaning to preparation grade 21/2 is designated BSa 21/2.

The standardized rust and preparation grades are defined by colour prints representing a full scale view of part of a surface.

The rust and preparation grades are illustrated in the following order.



Rust grades

A Steel surface covered completely with adherent mill scale and with little if any rust.

B Steel surface which has begun to rust and from which the mill scale has begun to flake.

C Steel surface on which the mill scale has rusted away or from which it can be scraped, but with little pitting visible to the naked eye.

D Steel surface on which the mill scale has rusted away and on which considerable pitting is visible to the naked eye.

Preparation grades. Scraping and wire-brushing

It is assumed that prior to treatment the steel surface has been cleaned of dirt and grease, and that the heavier layers of rust have been removed by chipping.

St 2 Thorough scraping and wire-brushing – machine brushing – grinding – etc. The treatment shall remove loose mill scale, rust and foreign matter. Finally, the surface is cleaned with-a vacuum cleaner, clean dry compressed air or a clean brush. It should then have a faint metallic sheen. The appearance shall correspond to the prints designated St 2.

St 3 Very thorough scraping and wire-brushing – machine brushing – grinding – etc. Surface preparation as for St 2, but much more thoroughly. After removal of dust, the surface shall have a pronounced metallic sheen and correspond to the prints deaig-

Preparation grades. Blast cleaning

It is assumed that prior to treatment the steel surface has been cleaned of dirt and grease, and that the heavier layers of rust have been removed by chipping.

Sa 1 Light blast cleaning. Loose mill scale, rust and foreign matter shall be removed. The appearance shall correspond to the prints designated Sa 1.

Sa 2 Thorough blast cleaning. Almost all mill scale, rust and foreign matter shall be removed. Finally, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It shall then be greyish in colour and correspond in appearance to the prints designated Sa 2.

Sa 2½ Very thorough blast cleaning. Mill scale, rust and foreign matter shall be removed to the extent that the only traces remaining are slight stains in the form of spots or stripes. Finally, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It shall then correspond in appearance to the prints designated Sa 2½.

Sa 3 Blast cleaning to pure metal Mill scale, rust and foreign matter shall be removed completely. Finally, the surface is cleaned with it vacuum cleaner, clean dry compressed air or a clean brush. It shall then have a uniform metallic colour and correspond in appearance to the prints designated Sit 3.

INITIAL CONDITIONS Before Cleaning	A Adherent Millscale A	B Rusting Millscale B	C Rusted C	D Pitted and Rusted D	NACE Nos.
Manual Cleaning—Thorough	Hand Tool Cleaning SSPC-SP2	B St 2	C St 2	D St 2	—
Manual Cleaning—Very Thorough	Power Tool Cleaning SSPC-SP3	B St 3	C St 3	D St 3	—
Blast Cleaning—Light	Brush-Off Blast Cleaning SSPC-SP7	B Sa 1	C Sa 1	D Sa 1	4
Blast Cleaning—Thorough	Commercial Blast Cleaning SSPC-SP6	B Sa 2	C Sa 2	D Sa 2	3
Blast Cleaning—Near-White	Near-White Blast Cleaning SSPC-SP10 A Sa 2½	B Sa 2½	C Sa 2½	D Sa 2½	2
Blast Cleaning-Very Thorough	White Metal Blast Cleaning SSPC-SP5 A Sa 3	B Sa 3	C Sa 3	D Sa 3	1

"Abrasive Blasting Guide for Aged or Coated Steel Surfaces"

FIGURES

1 – Representation of a Blasted Steel Surface, 67% Descaled ...
2 – Representation of a Blasted Steel Surface, 95% Descaled ...
3 – Representation of a Blasted Steel Surface, 99% Descaled ...
4 – Representation of a Blasted Steel Surface, 99.9% Descaled .
5 – Mild Steel, Uncoated with Mill Scale .....
6 – Mild Steel, Uncoated and Moderately Rusted .....
7 – Mild Steel, Uncoated but Severely Corroded and Pitted with Weathered Mill Scale .....
8.– Mild Steel, Coated .....
9 – Mild Steel, with Coating Failure and Light Rusting .....
10 – Mild Steel, Severely Corroded with Coating Failure .....
11 – Mild Steel, Severely Corroded with Extensive Coating Failure
12 – High Tensile Steel (approximately 50,000 psi yield), with Mill Scale .....
13 – High Tensile Steel (90,000 psi yield, max.), with Heavy Mill Scale .....

APPENDIX A

Definitions of Blast Cleaned Surfaces (SSPC/NACE) .....

Pictorial Representations of Surface Cleanliness

White	Near-White	Commercial
		✓
	✓	
	✓	
✓		
✓		✓
✓		✓
✓	✓	✓
✓		
✓	✓	✓
✓	✓	✓
✓		
✓	✓	
✓	✓	

SSPC.Vis 2-68T
September 1, 1968
(ASTM Designation 0610.68)

Editor Changes
January 1, 1971

Steel Structures Painting Council
Visual standard No. 2

STANDARD METHODS OF EVALUATING DEGREE OF RUSTING ON PAINTED STEEL SURFACES

This method has been jointly approved by the Steel Structures Painting council and the American Society of Testing and Materials.

1. SCOPE

1.1 The colored photographic reference standards available for use with this method are representative of degrees of rusting on painted steel (or iron) surfaces. They are to be used for comparative purposes and are not intended to have a direct relationship to a decision regarding painting requirements. These standards were developed in cooperation with the American Society for Testing and Materials to further standardization of methods.

2. TYPE OF RUSTING

2.1 The colored photographic reference standards and the associated rust-grade scale cover only rusting not accompanied by blistering and evidenced by visible rust.

NOTE 1 – Rust blistering beneath paint may be graded using the same scale by assuming the rust was completely visible and noting that the rusting was rust blistering.

3. RUST GRADE SCALE

NOTE 2 – The linear, numerical rust grade scale is an exponential function of the area of rust so that slight amounts of first rusting have the greatest effect on lowering the rust grade; the rust grade versus area of rust is a straight line plot on a semilogarithmic plot from rust grade 10 to rust grade 4. The slope of the curve was changed at 10 percent of the area rusted to 100 percent rusted to permit inclusion of. complete rusting on the 0 to 10 rust grade scale.

3.1 The scale and verbal description shown in Table 1 shall be used in conjunction with the photographic reference standards.

4 USE OF PHOTOGRAPHIC REFERENCE STANDARDS

NOTE 3 – The pictorial representations mustrated in Fig. 1 (taken from the Steel Structures Painting Manual, Vol. 2) show cxamples of area percentages which may be helpful in rust grading.

4.1 The use of the photographic reference standards (available separately from SSPC or ASTM) requires the following precautions:

4. 1. 1 Some finishes are stained by rust. This staining must not be confused with the actual rusting involved.

4.1.2 Accumulated dirt or other material may make accurate determination of the degree of rusting difficult.

4.1.3 Certain types of deposited dirt that contain iron or iron compounds may cause surface discoloration that should not he mistaken for corrosion.

4.1.4. It must be realized that failure may vary over a given area and discretion must therefore be used in applying these reference standards.

4.1.5 In evaluating. surfaces, consideration shall be given to the color of the finish coating, since failures will be more apparent on a finish that shows color contrast with rust, such as used in these reference standards, than on a similar color, such as an iron oxide finish.

4.1.6 The photographic reference standards arc not required for use of the rust-grade scale since the scale is based upon the percent of the area rusted and any method of asssessing area rusted may be used to determine the rust grade.

1 Replace, **D.610-43 of the ASTM.**

2 The colored photographic reference standards are available from the SSPC, 4400 Fifth Avenue, Pittsburgh. Pa. 15213 **or the ASTM.**

EVALUATING DEGREE OF RUSTING ON PAINTED STEEL SURFACES (SSPC-Vis 2-68T)

TABLE 1 – SCALE AND DESCRIPTION OF RUST GRADES

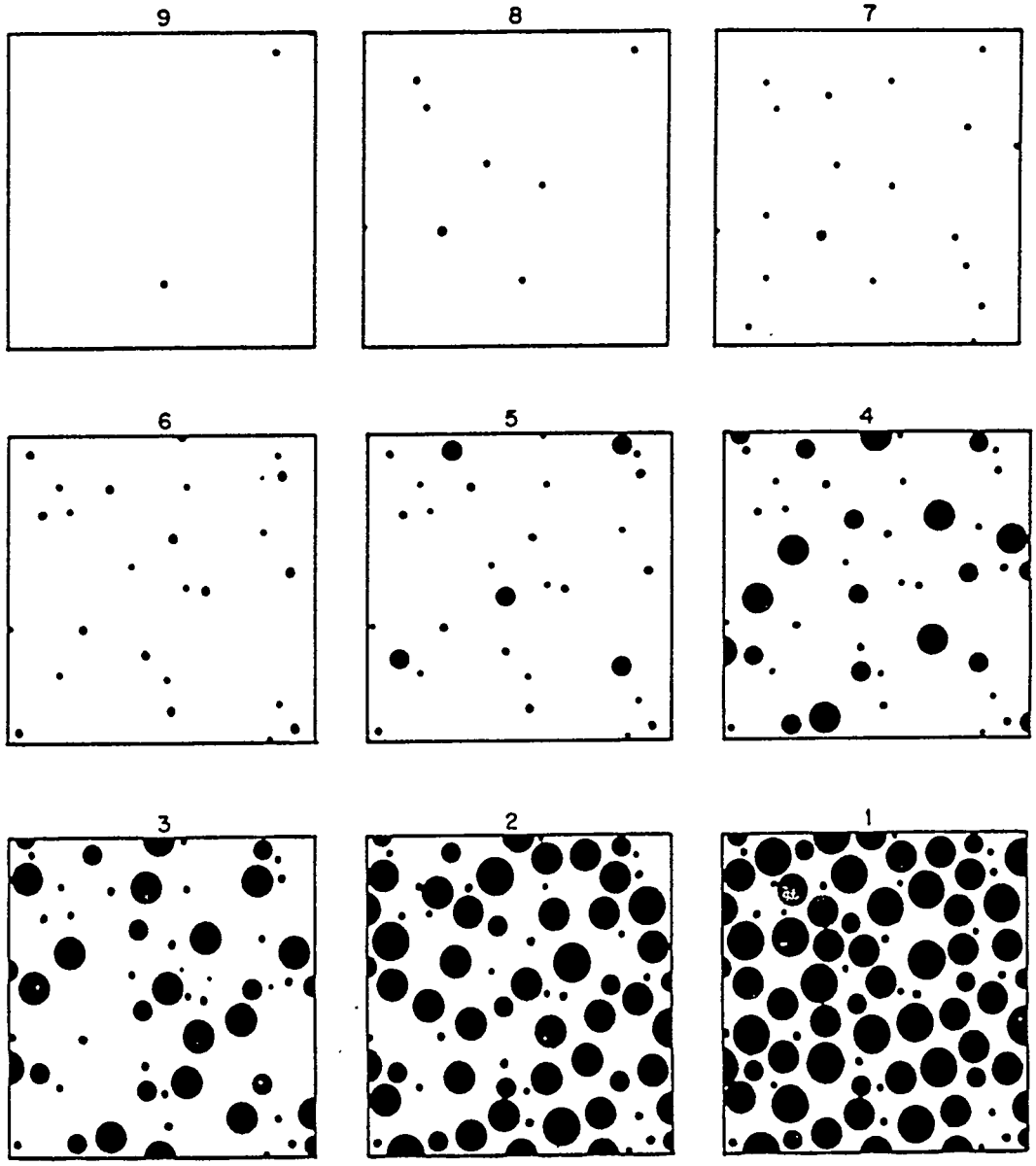
Rust Grades[1]	DESCRIPTION	ASTM. SSPC Photographic Stadard
10	no rusting or less than 0.01 percent of surface rusted	unnecessary
9	minute rusting, less than 0.03 percent of surface rusted	No. 9
8[b]	few isolated rust spots, less than 0.1 percent of surface rusted	No. 8
7	less than 0.3 percent of surface rusted	none
6[c]	extensive rust spots but less than 1 percent of surface rusted	No. 6
5	rusting to the extent of 3 percent of surface rusted	none
4[d]	rusting to the extent of 10 percent of surface rusted	No. 4
3[e]	approximately one sixth of the surface rusted	none
2	approximately one third of the surface rusted	none
1	approximately one half of the surface rusted	none
0[f]	approximately 100 percent of the surface rusted	unnecessary

a Similar to European Scale of Degree of Rusting for Anti-Corrosive Paints (1961) (black and white).
bCorresponds to SSPC Initial Surface Conditions E (0 to 0.1%) and (British Iron and Steel Research Association) 0.1%,
c Corresponds to SSPC Initial Surface Conditions F (0.1 to 1%) and BISRA 1.0%.
d Corresponds to SSPC Initial surface Condition G (1 .10%).
e Rust grades below 4 are of no practical importance in grading performance of paints.
f corresponds 10 SSPC Initial Surface Condition H (50. 100%).

FIGURE 1.

RATING OF PAINTED STEEL SURFACES AS A FUNCTION OF AREA PERCENT RUSTED

ASTM-D610/SSPC-Vis 2



Also attachecd:Excerpts from
SSPC,SP 5-63
SSPC SP 6-63

SSPC - SP 10-63T
october 1, 1963
Minor changes made and
Approved on October 1, 1967

Editorial changes January 1, 1971

Steel Structures Painting Council "surface Preparation Specifications

No. 10 Near-White Blast Cleaning

1. Scope

1.1 This specification covers the procedure required for the Near-White Blast Cleaning of structural steel surfaces prior to painting or coating.

2. Definition

2.1 Near-White Blast Cleaning is a method of preparing metal surfaces for painting or coating by removing nearly all mill scale, rust, rust-scale, paint, or foreign matter by the use of abrasives propelled through nozzles or by centrifugal wheels, to the degree hereafter specified.

2.2 A Near-White Blast Cleaned Surface Finish is defined as one from which all oil, grease, dirt, milI scale, rust; corrosion products, oxides, paint or other foreign matter have been completely removed from the surface except for very light shadows, very slight streaks, or slight discolorations caused by rust stain, mill scale oxides, or slight, tight residues of paint or coating that may remain. At least 95 percent of each squre inch of surface area shall be free of all visible residues, and the remainder shall be limited to the light discoloration mentioned above. Photographic or other visual standards of surface preparation may be used as provided in the Appendix to modify or further define the surface if specified in the contract.

2.3 The over-all blast cleaning effort expended (nozzle time) shall be not less than two-thirds (2/3) of that which would be required to produce a White Metal Surface Finish on the same surface; nor should more than ninety-five Percent (95%) of such effort be required, This limitation shall not be construed as a waiver of any of the above requirements.

3. Procedures

3.1 Near-White Blast Cleaning shall consist of the following sequence of operations:

3.1.1 Heavy deposit-s of oil or grease shall be removed by the methods outlined in Spec. SSPC-SP1-63, "Solvent Cleaning." Small quantities of oil or grease may be removed by the blast cleaning operation. If oil and grease are removed by blast cleaning, the abrasive shall not be reused if such reuse is detrimental to the surface.

3.1.2 Excessive rust-scale may be removed by impact tools, as outlined in Spec. SSPC-SP 2-63, "Hand Tool Cleaning," or SSPC-SP 3-63, "Power Tool Cleaning"' or by speciaI blast cleaning equipment.

3.1.3 The surface shall be blast cleaned to a Near-white Finish by any one of the following methods:

3.1.3.1 Dry sandblasting using compressed air blast nozzles and dry sand of a maximum particle size no larger than that passing through a 16 mesh screen, U. S. sieve series.

3.L3.2 Wet or water-vapor sandblasting using compressed air blast nozzles, water and sand of a maximum particle size no larger than that passing through a 16 mesh screen, U. S. sieve series.

3.1.3.3 Grit blasting using compressed air blast nuzzles and crushed grit made of cast iron, malleable iron, steel, or synthetic grits other than sand, of a maximum particle size no larger than that passing through a 16 mesh screen, U.S. sieve series. The largest commercial grade of melal grit permitted by this specification is SAE No. G-25 abrasive material.

3.1.3.4 Shot blasting using compressed air nozzles and cast iron, malleable iron, steel, or synthetic shot of a maximum size no larger than that passing

through a 16 mesh screen, U. S. sieve series. The largest commercial grade permitted by this specification is SAE No. S-330.

3.1.3.5 Closed, recirculating nozzle blasting using compressed air, vacuum, and any of the preceding abrasives.

3.1.3.6 Grit blasting using centrifugal wheels and crushed grit made of cast iron, malleable iron, steel, or synthetic grits of a maximum particle size no larger than that passing through a 16 mesh screen, U. S. sieve series. The largest commercial grade of metal grit permitted by this specification is SAE No. G-25.

3.1.3.7 Shot blasting using centrifugal wheels and cast iron, malleable iron, steel, or synthetic shot of a maximum particle size no larger than that passing through a 16 mesh screen, U. S. sieve series, The largest commercial grade permitted by this specification is SAE No. S-330.

3.2 The surface, if dry blasted, shall be brushed with clean brushes made of hair, bristle or fiber, or blown off with compressed air (from which detrimental oil and water have been removed), or cleaned by vacuum, for the purpose of removing any traces of blast products from the surface, and also for the removal of abrasive from pockets and corners.

3.3 The surface, if wet sandblasted, shall be cleaned by rinsing with fresh water to which sufficient corrosion inhibitor has been added to prevent rusting, or with fresh water followed immediately by an inhibitive treatment. This cleaning shall be supplemented by brushing, if necessary, to remove any residue.

3.4 The compressed air used for nozzle blasting shall be free of detrimental amounts of condensed water or oil. Adequate separators and traps shall be provided.

3.5 Blast cleaning operations shall be done in such a manner that no damage is done to partially or entirely completed portions of the work.

3.6 Dry blast cleaning operations shall not be conducted on surfaces that will be wet after blast cleaning and before painting, or when ambient conditions are such that any visible rusting. occurs before painting or coating.

If any rust forms after Mast cleaning, the surface shall be reblast cleaned before painting.

3.7 The blast cleaned surface shall be examined for any traces of oil, grease, or smudges. If present, they shall be removed as outlined in Spec. SSPC-SP 1-63, "solvent Cleaning."

3.8 The height of profile of the anchor pattern produced on the surface shall be limited to a maximum height that will not be detrimental to the life of the paint film. The maximum particle sizes specified in paragraphs 3.1.3.1 to 3.1.3.7 may produce an anchor pattern that is too high or too rough for the paint system to be used. In such cases the abrasive sizes should be reduced. If the application of the second coat of paint is deferred, .an adequate reduction in anchor pattern height shall be made.

3.9 The height of the anchor pattern can be determined by grinding a flat spot on the blasted surface until the bottoms of the pits are almost reached. The height may then be measured with a micrometer depth gauge graduated to read 0.001′ and with a base having a bearing length of two inches and a measuring rod of 3/32′ diameter.

3.10 The blast cleaned surface should be further" treated or primed, as specified in the agreement covering the work, preferably within 24 hours after blast cleaning when practicable, but in any event before any visible or detrimental rusting occurs. (See Section 3.6 and Appendix A.7)

Where chemical contamination of the surface may occur, the steel should be painted as soon as possible after blast cleaning.

4. Safety Precautions

4.1 If fire or explosion hazards are present, proper precautions shall be taken before any work is done. If the structure previously contained flammable materials, it shall be purged of dangerous concentrations.

4.2 Nozzle blast operators exposed to blast dust shall wear a U. S. Bureau of Mines approved helmet connected to a source of clean, compressed air.

4..3 Filter type air respirators should be worn by all others who are exposed to blast dust environment. Adequate protection for personnel from flying particles shall also be provided in any blasting operation.

4.4 Safety goggles shall be worn by all persons near any blasting operation.

4.5 Blast hose shall be grounded to dissipate static charges.

5. Inspection

5.1 All work under this specification shall be subject to inspection by the owner or his representative.. All parts of the work shall be accessible to the inspector. The contractor shall correct such work as is found defective under the specifications. If the contractor does not agree with the inspector, the arbi; tration or settlement procedure established in the contract, if any, shall be followed. If no arbitration or settlement procedure is established, the procedure specified by the American Arbitration Association shall be used.

Appendix

A.1 SCOPE. The recommendations contained in this appendix are believed to represent current good practice, but are not to be considered as requirements of the specification.

A.2 Near-White Blast Cleaning should be employed for all general purposes where a high degree of blast cleaning is required. It will remoye practically all rust, mill scale, and other detrimental matter from the surface. The surface will not necessarily be completely uniform in color, nor will all surfaces be uniformly clean. If the cleaning when done according to this specification is likely to result in a surface unsatisfactory to the owner or unsuitable for very severe service, then White Metal Blast Cleaning should be specified by the owner in the contract. The advantage of Near-White Blast Cleaning lies in the lower cost for surface preparation that is satisfactory for all but the most severe service conditions.

A.3 When this specification is used in maintenance painting, specific instructions should be given on the extent of surface to be blast cleaned in accordance with this specification and the amount of spot cleaning required. In maintenance painting it is not ordinarily intended that sound, adherent old paint be removed unless it is excessively thick or inflexible.

In preparing a previous]y painted surface, it is necessary to remove all corrosion and all paint which shows evidence of corrosion, pceling, excessive thickness, brittleness, bliscring, checking, scaling or general disintegration. It is essential that the removal of the old paint be carried back around the edges of the spot or area until an area of completely intact and adhering print film, with no rust or blisters underneath, is attanied. Edges of tightly adherent paint remaining around the area to be recoated must be feathered, so that the repainted surface can have a smooth appearance. The remaining old paint should have sufficient adhesion so that it cannot be lifted as a layer by inserting a blade of a dull putty knife under it. The rate of-blast cleaning may vary from one area to the next, in order to achieve the desired end condition.

A.4 The maximum permissible size of the abrasive particles will depend upon the allowable surface roughness or "maximum height of profile" of the surface; the allowable maximum height of profile is in turn, dependent upon the thickness of paint to be applied.

The maximum height of profile is the height of the anchor pattern produced on the surface, measuring from the bottoms of the lowest pits to the tops of-the highest peaks.

A typical maximum height of profile produced by a number of different abrasives in actual blast cleaning operations has been measured as follows:

Abrasive	Maximum Particle Size	Maximum Height of Profile
Sand, very line	through 80 mesh*	1.5 roils
Sand, fine	through 40 mesh	1.9
Sand, medium	through 18 mesh	2.5
Sand, large	through 12 mesh	2.8
**Steel grit #G-80	through 40 mesh	1.3-3.0
**Iron grit #G-50	through 25 mesh	3.3
Iron grit #G-40	through 18 mesh	3.6
Iron grit #G-25	through 16 mesh	4.0
Iron grit #G-16	through 12 mesh	8.0
*Steel shot #S-170	through 20 mesh	1.8-2.8
Iron shot #S-230	through 18 mesh	3.0
Iron shot {S-330	through 16 mesh	3.3
Iron shot #S-390	through 14 mesh	3.6

* U.S. Sieve Scrics. l "Operating mixtures.

**Crushed iron grit.

SSPC is useful-in estimating sand blast profile depth.

Maximum profile will vary somewhat with the angle and velocity of particle, with the hardness of surface, with the amount of recycling of working mixtures (of shot, and grit) and with the thoroughness of blast cleaning.

A.5` The dry Paint film *thickness above* the peaks Of the profile should equal the thickness known to be needed over a smooth surface for the desired protection. If it is not possible to use an abrasive sized small enough to produce a desirable height of profile, the dry paint film thickness should be in-4 to provide adequate thickness above the peaks.

A.6 A suitable inhibitive treatment for blast cleaned surfaces is water containing 0.32 per cent of sodium nitrite and 1.28 per cent by weight of ammonium phosphate, secondary (diabasic), or as an alternate water containing about 0.2 per cent by weight of (a) chromic acid or (b) sodium chromate or (c) sodium dichromate or (d) potassium dichromate. Note: If solutions containing either chromates or dichromates are used, precautions should be taken to protect personnel from hazards resulting from breathing spray or contacting the solution.

A.7 The blast cleaned surface must be treated or primed before any rusting occurs. Otherwise the benefit of the Near-White Blast Cleaning is lost. The freshly exposed bare metal will rust quickly under conditions of high humidity, when wet, or when in a corrosive atmosphere. Under normal mild atmospheric conditions it is best practice to prime or chemically treat within 24 hours after blast cleaning. Under no circumstances should the steel be permitted to rust before painting, regardless of the time elapsed.

Moisture condenses on any surface that is colder than the dew point of the surrounding air. It is therefore recommended that dry blast cleaning should not be conducted when the steel surface is less than 5°F above the dew point.

The permissible time interval between blast cleaning and priming will vary greatly (from minutes to weeks) from one environment to another, in order that the surface remain free of corrosion, oil, etc. as required by Sections 3.6, 3.7, and 3.10. lf a maximum interval is desired it shall be so specified in the contract covering the work.

A.8 Photographic standards of comparison may be used to define the final surface condition to be supplied under this specification. For partially rusted mill scale, for completely rusted mill scale, or for completely rusted and pitted surfaces, the appearance of the surface after Near.White Blast Cleaning should correspond with pictorial standards B Sa 2½, C Sa 2½ and D Sa 2½ of SSPC Vis 1-67T. As additional standards become available, these may be included by reference in the contract.

The color of the cleaned surface maybe affected by the nature of the abrasive used.

A.9 Other visual standards of surface preparation may be used as required by the owner when they are specified in the contract to illustrate the d- of metal cleanliness required. The owner will provide the specified samples or standards of such size and condition that they may be compared during the entire contract. If blast cleaned steel samples are used, they should be completely protected *from* co Tosion during the period of the contract.

A.10 If specifided in the contract, a percentage other than 95%, of the surface area may be designated in Section 2.2.

SSPC SP 6-63 '' Ccmmercial Blast Cleaning"

These paragraphs are the only ones that differ from SSPC SP 10-63

2.2 A Commercial Blast Cleaned Surface Fin. ish is defined as one from which all oil, grcasc, dirt, rust scale and foreign matter have been completely removed from the surface and all rust, mill scale, and old paint have been completely removed except for slight shadows, streaks, or discolorations caused by rust stain, mill scale oxides or slight, tight residues of paint or coating that may remain; if the surface is pitted, slight residucs of rust or paint, may 'be found in the bottom of pits; at least two-thirds of each square inch of surface area shall be free of all visible residues and the remainder shall be limited to the light discoloration, slight staining or tight residues mentioned above. Photographic or other visu-. al standards may be used as provided in the Appendix to modify or further define the surface if specified in the contract.

A.2 Commercial Blast Cleaning should be employed for all general purposes where a high, but not perfect, degree of blast cleaning is required. It will remove practically all rust, mill scale, and other detrimental matter from the surface. The surface will not necessarily be uniform in color, nor will all surfaces be uniformly clean If the cleaning done according to this specification is likely to result in a surface unsatisfactory to the owner or unsuitable for severe service, then Near-White Blast Cleaning or White Metal Blast Cleaning should be spccified by the owner in the contract. The advantage of commercial blast cleaning lies in the lower coat for Satisfactory surface preparation for most Service conditions.

A.8 Photographic standards of comparison may be used to define the final surface condition to be supplied under this specification. For partially rusted mill scale, for completely rusted mill scale, or for completely rusted and pitted surfaces, the appearance of the surface' after Commercial Blast Cleaning should cor-. respond with pictorial standards B Sa 2, C Sa 2, or D Sa 2 of SSPC-Vis 1-67T.

The color of the cleaned surface maybe affected by the nature of the abrasive used.

This correlation is cross-referenced in these visual standards, which were developed by the Swedish IVA, and have been mutually adopted by the Swedish Standards Association, the ASTM and the SSPC. As additional standards become available, particularly for initial surface conditions such as previously painted steel, these may be included by reference in the contract.

A.10 This specification is based upon the desired end condition and not upon a rate-of-cleaning test. In the past, a referee rate-of-cleaning test was used in place of this current specification. It stipulated that the surface be cleaned at least as well as one which is nozzle blast cleaned with dry ottawa Silica Sand, American Foundry man's Association Standard Grade No. 27*, through a new nozzle with a one-quarter inch diameter bore: using an air pressure of 90 pounds per aquare inch gage at the *en*-trance to the nozzle. During this test, the nozzle was held at the optimum angle and distance *for* the particular surface being Cleaned. In this test, a plane or slightly curved surface was cleaned at a rate *of three* square feet per minute (or other standard rate). This test (now obsolete) established a standard for surface preparation and was not under any circumstances stipulated as a production rate of cleaning.

A standard end condition may be prepered in situ or on a test piece as provided under A.9 .

•Mesh	20	30	40
%(Cum.)	1.5	38.0	93–95

All If specified in the contract, a fraction other than two-thirds of the surface area may be designated in Section 2.2.

SSPC SP 5-63 ‘White Metal Blast Cleaning”

These paragraphs are the only ones that differ from SSPC SP 10-63

2.2 A White Metal Blast Cleaned Surface Finish is defined as a surface with a gray-white, uniform metallic color, slightly roughened to form a suitable anchor pattern for coatings. The surface, when viewed without magnification, shall be free of all oil, grease, dirt, visible mill scale, rust, corrosion products, oxides, paint, or any other foreign matter. The color of the clean surface may be affected by the particular abrasive mcdiu.me used. Photographic or other visual standards of surface preparation may be used as provided in the Appendix to further define the surface if specified in the contract.

A.2 White Metal Blast Cleaning should be employed when the protective coating or environment is such that no rust, mill scale, or other foreign matter can be tolerated on the surface of the steel. The cost of attaining such cleaning will be high as compared to the 1ess critical Near-White Blast Cleaning or Commercial Blast Cleaning which may be adequate for most conditions.

In White Metal Blast Cleaning, the “cleaning rate and subsequent costs are subject to wide variations due to the difficulty of removing all rust, mill scale, paint, etc. from the various surfaces that may be encountered. The final surfaces will be uniform in their degree of cleanliness, despite great differences in the original surfaces.

A.8 Photographic standards of comparison may be used to define the final surface condition to be supplied under this specification. For intact mill scale, for partially rusted mill scale, for completely rusted mill scale, or for completely rusted and pitted surfaces, the appearance of the surface after White Metal Blast Cleaning should correspond with pictorial standards A Sa 3, B Sa 3, C Sa 3, or D Sa 3 of SSPC-Vis 1-67T.

This correlation is cross-referenced in these visual standards, which were developed by the Swedish IVA, and have been mutually adopted by the Swedish Standards Association, the ASTM and the SSPC. As additional standards become available, particularly for initial surface conditions such as previously painted steel, these may be included by reference in the contract.

The color of the cleaned surface maybe affected by the nature of the abrasive used.

A.10 With the agreement of both contractual parties, examination under magnification or examination by chemical methods may be used in the evaluation of the cleanliness of the surface.

Steel Structures Painting Council

SURFACE PREPARATION SPECIFICATION NO. 10

Near-White Blast Cleaning

1. Scope

1.1 This specification covers the requirements for near.white blast cleanlng of steel surfaces.

2. Definition

2.1 Near-white blast cleaning is a method of preparing steel surfaces which, when viewed without magnifisation, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, and paint. Generally, evenly dispersed very Iight shadows, streaks, and discolorations caused by stains of rust, stains of mill scale, and stains of previously applied paint may remain on no more than 5% of the surface.

3. Appearance of the Completed Surface

3.1 The surface shall. be roughened to a degree suitable for the specified paint system.

3.2 The appearance of the surface may be affected by the particular blasting abrasive used. Uniformlly of color may be affected by the grade, original surface condition, and configuration of the material being cleared,as well as by discolorations from mill or fabrication marks, and the shadowing from blast cleaning patterns.

3.3 SSPC.VIs 1 or other visual standards of surface preparation agreed upon by the contracting parties maybe used to further define the surface.

4. Reference Standards

4.1 The standards referenced In this specification are Iisted In Section 4.4 and form a part of the specification.

4.2 The latest issue, revision, or amendment of the reference standards In effect on the date of invitation to bid shall govern unless otherwise specified.

4.3 If there is a conflict between the requirements of any of the cited reference standards and the specification, the requirements of the specification shall prevail.

4.4 STEEL STRUCTURES PAINTING COUNCIL (SSPC) SPECIFICATIONS:

SP 1	Solvent Cleanlng
Vls 1	Plctorial Surface Preparation Standards for Painting Steel Surfaces

5. Surface Preparation Before and After Blast Cleaning

5.1 Before blast cleanlng, remove visible deposits of oll or grease by any of the methods specified in SSPC.SP 1.

5.2 AFTER BLAST CLEANING AND PRIOR TO PAINT. ING, PERFORM THE FOLLOWING:

5.2.1 Remove rust which becomes visible" when viewed without magnification.

5.2.2 Remove visible deposits of oll, grease, or other contaminants (see Section 5.1).

5.2.3 Remove dust and loose residues from dry abrasive blast cleaning. Acceptable methods include brushing, blow off with clean, dry air, or vacuum cleaning. (When compressed air is used for blow off, use and maintain moisture and oll separators and traps to provide a clean and dry air supply.)

5.2.4 If the surface was wet abrasive blast cleaned, rinse with fresh water to which sufficient corroslon Inhib. Itor has been added to prevent rusting, or with fresh water followed by an inibitive treatment. Supplement this clean. ing by brushing, If necessary, to remove any residues.

5.3 Rectify surface imperfections which become visl. ble after blast cleaning as specified in the procurement documents.

6. Blast *Cleaning* Methods and Operation

6.1 METHODS:

6:1.1 Dry abrasive blasting using compressed air, blast nozzles, and abrasive;

6.1.2 Dry abrasive blasting using a closed cycle, recir. culatlng abrasive system with compressed air, blast noz. zle, and abrasive, with or without vacuum for abrasive recovery;

6.1.3 Dry abrasive blasting, using a closed cycle, recirculating abrasive system with centrifugal wheels and abrasive;

6.1.4 Wet abrasive blasting using compressed air, blast nozzles, water, and abrasive followed by rinse (see Section 5.2.4).

6.2 OPERATION

6.2.1 When compressed air Is used for nozzle blast. ing, use and maintain moisture and oil separators and traps to provide a clean, dry air supply.

6.2.2 Perform blast cleaning operations sc that no damage Is done to partially or entlreiy completed portions of the work.

7. Blast Cleaning Abrasives

7.1 ABRASIVES SHALL CONFORM TO THE FOLLOW* ING REQUIREMENTS:

7.1.1 The abrasive shall be free of corrosion-produc" ing contaminants and also free of oil, grease, or other deleterious contaminants.

7.1.2 Selection of abrasive size and type shall be based on the type, grade, and surface condition of the steel to be cleaned, and on the finished surface to be pro duced for the subsequent paint system.

7.1.3 The cleanliness and sizing of the abrasive shaft be maintained to insure compliance with this specifica. tion.

8. inspection

8.1 All work and materials supplied under this specf" fication shall be subject to timely Inspection by the pur" chaser or his authorized representative. The contractor shall correct such work or replace such material as is found defective under this specification. In case of dispute the arbitration or settlement procedure established In the procurement documents, if any, shall be followed. if no arbitration or settlement procedure is established, the pro cedure specified by the American Arbitration Association. shall be used.

8.2 The procurement documents covering work or purchase should establish the responsiblity for testing and for any required affldavit certifying full compliance with the specification.

9. Safety

9.1 AH safety requirements stated in this specIfIca. tion and its component parts apply In addition to any ap- pllcable federal, state, and local rules and requirements. They also shall be In accord with instructions and require. ments of insurance underwriters,

10. Notes

10.1 While every precaution is taken to insure that all information furnished In SSPC specifications is as ac. curate, complete, and useful as possible, the SSPC cannot assume responsibility or incur any obligation resulting from the use of any materials, paints, or methods specified therein, or of the specification Itself.

10.2 A Commentary Section is available (Chapter 2 of Volume 2 of the Steel Structures Painting Manual) and con. tains additional information and data relative to this spec. ification. The Surface Preparation Commentary is not part of this specification. The table below lists the subjects dis. cussed relevant to near.white blast cleaning and appro priate Commentary Section,

Subject	Commentary Section
Abrasive Selection	5.0
Degree of Cleaning	11.0
Fllm Thickness .:	10.0
fnhibitors	9.0
Maintenance Painting	3.2
Rust Back	8.0
Surface Profile	6,0
Visual Standards	7.0
Weld Spatter	4.1

These paragraphs are the only ones that differ from SSPC SP 10-82

SSPC SP 5-82

2. Definition

2.1 White metal blast cleaning is a method of preparing steel surfaces which, when viewed without magnification, shall be free of ail visible oil, grease, dirt, dust, mill scale, rust, and paint.

32 The completed surface shall be cleaned to a gray. white metallic color. The appearance of the surface may be affected by the particular blasting abrasive used. Uniformity of color maybe affected by the grade, original surface condl- tlon, and configuration of the material being cleaned, as well as by discolorations from mill or fabrication marks, and the shadowing from blast cleaning patterns.

SSPC SP 6-82

2. Definition

2.1 Commercial blast cleaning is a method of preparing steel surfaces which, when viewed without magnification, shall be free of all visible ~oil, grease, dirt, dust, mill scale, rust, and paint. Generally evenly dispersed very Iight shadows, streaks, and discolorations caused by stains of rust, stains of mill scale, and stains of previously applled paint may remain on no more than 33% of the surface. Slight residues of rust and paint may also be left in the craters of pits if the original surface is pitted.

3.2 The appearance of the surface may be affected by the particular blasting abrasive used. Uniformity of color may be affected by the grade, original surface condition, and con. figuration of the material being cleaned, as well as by dls colorations from mill or fabrication marks, and the shadow. .~ from blast cleaning patterns.

Steel Structures Painting Council
SURFACE PREPARATION SPECIFICATIONS
Surface Preparation Commentary

1. Introduction

This Surface Preparation Commentary Is Intended to be an ald for selecting the proper surface preparation specifications for a given job and for determining when the desired surface preparation is accomplished. The Commentary is not part of the actual specifications, but is in. eluded In order to provide a better understanding of the SSPC surface preparation specifications. In addition, surface preparation specifications other than those published by SSPC are referenced.

The SSPC specifications, summarized in Table 1, were thoroughly reviewed betwean 1975 and 1982 and represent a broad consensus of users, suppliers, and public Interest groups. Certain rewordings were effected for clarification of the specifications, but no changes in the basic requirements were made or Intended. Many details previously presented in the specifications themselves are now found in this Commentary.

2. Importance of Surface Preparation

The life of a coating depends as much on the degree of surface preparation as on the subsequent coating system. Surface preparation, therefore, should receive thorough consideration. The primary functions of surface preparation are:

- l To clean the surface of material that will induce premature failure of the coating system.
- c To provide a surface that can be easily wetted for good coating adhesion.

It must be borne In mind that all coating systems wiII fall eventually. However, most premature coating failure can be attributed to Inadequate surface preparation or lack of coating adhesion.

Typical contaminants that should be removed during surface preparation are moisture, oil, grease, chloride salts, sulfate salts, rust, corrosion products, and dirt. Mill scale Is erratic In Its effect upon the performance of coat. Ings. Tightly adhered or Intact mill scale does not have to be removed for mild atmospheric exposure. If, however, the steel surface Is to be coated with primers with low wet. tlng properties or exposed to severe environments such as chemical exposures and Immersion In fresh or salt water, Ihen removal of mill scale by blast cleaning to a minimum SSPC.SP 10, "Near.White Blast Cleanlng," 18 necessary,

3. Initial Surface Conditions

The amount of work, time, and money required to achieve any particular degree of thoroughness of surface preparation will depend upon the initial condition of the surface to be cleaned. It is much more difficult to remove contaminants from rusty steel than from intact mill scale. Therefore, it is necessary to consider the amount of mill scale, rust, old paint, contamination, and pitting on the surface to be protected. Although there are almost an infinite number of Initial conditions, they can be broadly divided into three categories as follows:

- l New construction – steel not previously painted;
- l Maintenance – previously painted steel:
- • Surface imperfections – common to both new con. struction and maintenance.

3.1 NEW CONSTRUCTION: The first four surface con ditions (designated A through D) are based upon the rust. grade classifications of SSPC-VIS 1, "Pictorial Surface Preparation Standards for Painting Steel Surf aces." Normally, a more thorough surface preparation should be used with rustgrades C or D compared with rustgrades A or B.

- A Steel surface covered completely with adherent mill scale with Iittle, if any rust (SSPC-Vis 1 – Rustgrade A).
- B Steel surface which has begun to rust, and from which the mill scale has begun to flake (SSPC.VIS 1 – Rustgrade B).
- c Steel surface from which most of the mill scale has rusted away or from which it can be scraped, but with little pitting visible (SSPC-VIS 1- Rustgrade C).
- D Steel surface where the mill scale has rusted away and where pitting Is visible (SSPC-Vis 1 – Rust. grade D).

3.2 MAINTENANCE Four grades of previously painted steel have also been established and represent the range of Initial surface conditions encountered In maintenance repainting. The maximum amounts of rust In grades E, F, G, and H represent a geometric progression with each per. centage ten times that of the preceding grade (0.1%, 1′/0,

TABLE 1
SUMMARY OF SURFACE PREPARATION SPECIFICATIONS

SSPC Specification	SSPC.Vis 1 Photograph	Description
SP 1, Solvent Cleaning		Removal of oil, grease, dirt, soil, salts, and contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
SP 2, Hand Tool Cleaning	B, C, DSt2	Removal of loose rust, loose mill scale, and loose paint to degree specified, by hand chipping, scraping, sanding, and wire brushing.
SP 3, Power Tool Cleaning	B, C, DSt3	Removal of loose rust, loose mill scale, and loose paint to degree specified, by power tool chipping, descaling, sanding, wire brushing, and grinding.
SP 5, White Metal Blast Cleaning	A, B, C, DSa3	Removal of all visible rust, mill scale, paint, and foreign matter by blast cleaning by wheel or nozzle (dry or wet) using sand, grit, or shot. (For very corrosive atmospheres where high cost of cleaning Is 'warrant~d.)
SP 6, Commercial Blast Cleaning	C, DSa2	Blast cleaning until at least two-thirds of the surface area is free of all visible residues. (For rather severe conditions of exposure.)
SP 7, Brush-Off Blast Cleaning	B, C, DSa1	Blast cleanlng of all except tightly adhering residues of mill scale, rust, and coatings, exposing numerous evenly distributed flecks of underlying metal.
SP 8, Pickling		Complete removal of rust and mill scale by acid pickling, duplex pickling, or electrolytic pickling.
SP 10, Near-White Blast Cleaning	B, C, D Sa 2.1/2	Blast cleaning nearly to White Metal cleanliness, until at least 95%40 of the surface area is free of all visible residues. (For high humidity, chemical atmosphere, marine, or other corrosive environments.)
Vis 1, Pictorial Surface Preparation Standards for Painting Steel Surfaces		Photographic standards used as specification; optional supplement to SSPC - Surface Preparation Specifications 2,3,5,6,7, and 10.
Vis 2, Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces		A geometric numerical scale for evaluating degree of rusting of painted steel. Illustrated by color photographs and black and white dot diagrams.

10%, 100%). These grades are consistent with those established in the photographic standard SSPC-VIS 2/ASTM-D 610, "Standard Method of Evaluating Degree of Rusting on Painted Surf aces."

E Paint almost Intact; some primer may show; rust covers less than one-tenth of one percent of the surface (SSPC.vis 2 – Rustgrades 8 to 10).

F Finish coat somewhat weathered; primer may show; sllght staining or blistering; after stains are wiped off, less than one percent of area shows rust, blistering, loose mill scale, or loose paint film (ssPc.vis 2 – Rustgrades 6 to 8).

G Paint thoroughly weathered, blistered, or stained; up to ten percent of surface is covered.with rust, rust blisters, hard scale or loose paint film; very littie pitting visible (SSPC-Vis2– Rustgrades 4 to 6).

H Large portion of surface is covered with rust, pits, rust nodules, and non-adherent paint. Pitting is VIS. Ible (SSPC-VIS 2 - Rustgrades 0 to 4).

In approximating estimates of rust percentages, photographs and schematic diagrams of the type shown in SSPC.Vis 2 can serve as practical aids. Figure 1 of the Guide to SSPC.Vis 2 shows a series of 1.5 inch squares with black dots representing various area percentages. These diagrams are not intended to reproduce the appearance of actual rust patterns but merely to serve as a guide forejudging the percentage of surface covered by rust (after removal of stains) or rust blisters. The SSPC Painting System Commentary will also help in estimating surface preparation requirements.

Comments on surface preparation for maintenance repainting are given in SSPC.PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems." This guide includes a description of accepted practices for retaining old, sound paint, removing unsound paint, feathering, and spot cleaning.

4. Surface Imperfections

Surface imperfections can cause premature failure when the service is severe. Coatings tend to pull away from sharp edges and projections, leaving little or no coating to protect the underlying steel. Other features which are difficult to properly cover and protect Include crevices, weld porosity, laminations, etc. They are discussed below. The high costs of the methods to remedy the surface imperfections requires weighing the benefits of edge rounding, weld spatter removal, etc., versus a potential coating failure.

Poorly adhering contaminants, such as weld slag residues, loose weld spatter, and some minor surface laminations, may be removed during the actual surface preparation operation (e.g., blast cleaning). Alternately, other surface defects – such as steel laminations, weld porositles, or deep corrosion pits – may not be evident until the surface preparation operation has been done. Therefore, the timing of such surface repair work may occur before, during, or after preliminary surface preparation operations have begun.

4.1 WELD SPATTER: Weld spatter should be removed prior to blast cleaning. Most weld spatter, except that which Is very tightly adherent, can be readily removed using a chipping hammer, spud bar, or scraper. Tightly adhering weld spatter may require removal by grinding.

4.2 POROSITY Areas of unacceptable porosity as defined in the American Welding Society standard AWS D1.1 should be filled with acceptable filler material or closed over with a needle gun or peening hammer prior to palnting. Acceptable weld profiles, arc strikes, and weld cleaning are also addressed In Section 3 of "Structural Welding Code" AWS D1.1.

4.3 SHARP EDGES: Sharp edges, such as those normally occurring on rolled structural members or plates, as well as those resulting from flame cutting, weldlng, grinding, etc., and especially shearing, may be removed by any suitable method (e.g., grinding, mechanical sanding, filing). Care should be taken to ensure that during the removing operations, new sharp edges are not created.

4.4 PITS: Deep corrosion pits, gouges, clamp marks, or other surface discontinuities may require grinding prior to painting. The surface will require filling.

4.5 LAMINATIONS, SLIVERS: Rolling discontinuities (laps) may have sharp protruding edges and deep penetrating crevices and such defects should be eliminated prior to painting. Various methods can be used to eliminate minor slivers (e.g., scraping and grinding). All sharp fins, projections, or edges should be removed.

4.6 CREVICES: Areas of poor design for corrosion protection, such as tack or spot welded connections, back-to-back angles, crevices, etc., may require special atten. tion. Where possible, such deficiencies should be cor. rected by structural or design modification. Where this is not possible, particular consideration should be devoted to minimize the effect of such deficiencies.

5. Abrasive Selection

The selection of the size and type of abrasive which will most effectively and economically produce the desired surface finish is not, unfortunately, an exact science, because of the many variables involved. These variables include at least the following:

- The nature of the steel being cleaned, i.e., the hard. ness and the degree of rusting which may have developed prior to blast cleaning.
- The basic purpose for blast cleaning, which may include either new construction or maintenance and repair programs.
- The type of surface finish desired, i.e., degree of cleanliness and height of profile required to meet the specification or requirement of the paint to be applied. See SSPC report on "Surface Profile for Anti-Corrosion Paints."
- The type of blast cleaning systems which may be employed, e.g., centrifugal wheel or airblast recircufating abrasive systems for shop or on-site cleaning, or on-site, open nozzle airblasting with non-recoverable abrasives.

In general, select the smallest size abrasive that wiII produce the desired cleaning results. Usually, this will give the fastest, most economical cleaning operation.

General Information concerning the chemical and physical properties of cast steel shot and grit, and the physical properties of various non-metallic abrasives along with information on their usage, are presented In the following sections.

5.1 CAST STEEL ABRASIVES: Steel shot consists of nearly spherical particles of steel obtained by granulating a molten stream of metal with water, air, or other methods. Steel shot will generally conform to the Society of Automotive Engineers SAE J827 (Recommended Practice) In terms of hardness, chemical composition, size, and micro. structure.

Cast steel grit consists of angular particles produced by crushing steel shot (SAE J827). Steel grit Is available In a wide range of hardnesses, from 30 to 66 Rockwell C, produced by varying the tempering time cycles to which the grit is subjected. Generally, the three hardnesses most commonly produced are In the ranges of 40-50 Rockwell C, 55-60 Rockwell C, and 60-66 Rockwell C. The first two hardness ranges are used for structural steel, and the latter is used primarily for selective application where deep, consistent, sharp etched finishes are required, or where moderate etches on extremely hard surfaces are needed.

Steel shot will produce a peened surface texture whereas steel grit produces more of an etched surface texture. The etch becomes more pronounced with increasing abrasive hardness.

Typical applications of various steel abrasives, referring to rustgrade classifications described in Section 3.1 are:

- Shot: Commonly used for Rustgrades A and B.
- Grit (40-50 RC): Most effective on Rustgrades C and D, but also commonly used for Rustgrades A and B.
- Shot/Grit (Shot 40-50 RC/Grit 55-60 RC Mixture): This is not common practice; however, it is acceptable for all Rustgrades, particularly for Rustgrades C and D. NOTE Such a mixture is difficult to maintain in the desired proportions In a workmix (operating mix) of shot/grit since the grit, being harder and more friable than the shot, will break down at a faster rate than the shot. However, the desired proportions of shot/grit can be maintained, In the oper-sting mix, *provided* new abrasive added to the machine is of the proper proportions. Generally speaking, the amount of grit in the newly added mix must be greater than the amount of grit desired in the operating mix. Maintaining this type of operating mix therefore demands careful attention and close control of abrasive additions by the operator.

Tables 2, 3, 4A, and 4B summarize the properties of metallic abrasives, types and sizes most commonly used for various cleaning operations, and the SAE shot and grit size specifications.

5.2 NON-METALLIC ABRASIVES will vary in shape, size, hardness, and density. The abrasives should be clean and free from contaminants, and graded properly for the specific product. Tables 5, 6 and 7 provide information on abrasive selection.

TABLE 2
STEEL SHOT AND GRIT SPECIFICATIONS'

Property	Shot	Grit
SIZE		
New abrasive as manufactured	All material is screened to meet *or* exceed SAE HJ444 and SFSA #20.66 Specifications[3]	
CHEMISTRY		
Carbon	0.85 to 1.20 %	
Manganese	0.60 to 1.00 %	
Silicon	0.50 to 1.00%	
Sulfur	<0.05 %	
Phosphorous	<0.05 %	
MICROSTRUCTURE	Uniformly tempered martensite, with fine, well distributed carbides, if any. Carbide net. works, transformation product% decarburized surfaces, inclu. sions, and quench cracks are undesirables.	
HARDNESS:		
Commonly used structural steel	40 to 50 RC	40 to 50 RC' 40 to 60 RC

[1] SAE (Society of Automotive Engineers, Inc.)
400 Commonwealth Drlve
Warrendale, PA 15096

SAFA (Steel Founders" Society of America)
20611 Center Ridge Road
Rocky River, Ohio 44116

[2] Both cast steel shot and grit of hardnesses *in* the range of from 30 to 66 Rockwell C may be purchased. However, the abrasives of less than 40 RC and greater than 60 RC are generally used for applications other than surface preparation of structural steel.

[3] Abrasive manufacturers Identify steel grit by designations which include two *or* more prefix letters, followed by the number size. Prefix *Ietters* are different for each of the abrasive suppliers for any given hardness range.

[4] It Is extremely important that contractual documents which specify abrasives to be used clearly *deslgnate* the *abrasive by size and by hard. ness.*

TABLE 4B
CAST GRIT SPECIFICATIONS FOR BLAST CLEANING

NBS Screen No.	Standard[a] (mm)	Screen Size (in)	Screen Opening Sizes and Screen Numbers with Minimum Cumulative Percentages Allowed on Corresponding Screens SAE Grit Number											
			G10	G12	G14	G16	G18	G25	G40	G50	G80	G120	G200	G325
4	4 75	0.187	—	—	—	—	—	—	—	—	—	—	—	—
5	4.00	0.157	—	—	—	—	—	—	—	—	—	—	—	—
6	3.35	0.132	—	—	—	—	—	—	—	—	—	—	—	—
7	2.80	0.111	All Pass	—	—	—	—	—	—	—	—	—	—	—
8	2.36	0.0937	—	All Pass	—	—	—	—	—	—	—	—	—	—
10	2.00	0.0787	80%	—	All Pass	—	—	—	—	—	—	—	—	—
12	1.70	0.0661	90%	80%	—	All Pass	—	—	—	—	—	—	—	—
14	1.40	0.0555	—	90%	80%	—	All Pass	—	—	—	—	—	—	—
16	1.18	0.0469	—	—	90%	75%	—	All Pass	—	—	—	—	—	—
18	1.00	0.0394	—	—	—	85%	75%	—	All Pass	—	—	—	—	—
20	0.850	0.0331	—	—	—	—	—	—	—	—	—	—	—	—
25	0.710	0.0278	—	—	—	—	85%	70%	—	All Pass	—	—	—	—
30	0.600	0.0234	—	—	—	—	—	—	—	—	—	—	—	—
35	0.500	0.0197	—	—	—	—	—	—	—	—	—	—	—	—
40	0.425	0.0165	—	—	—	—	—	80%	70%	—	All Pass	—	—	—
45	0.355	0.0139	—	—	—	—	—	—	—	—	—	—	—	—
50	0.300	0.0117	—	—	—	—	—	—	80%	65%	—	All Pass	—	—
80	0 180	0.007	—	—	—	—	—	—	—	75%	65%	—	All Pass	—
120	0.125	0.0049	—	—	—	—	—	—	—	—	75%	60%	—	All Pass
200	0 075	0.0029	—	—	—	—	—	—	—	—	—	70%	55%	—
325	0.045	0.0017	—	—	—	—	—	—	—	—	—	—	65%	20%

[a]Corresponds to ISO Rccommendation.

CAST SHOT AND GRIT SIZE SPECIFICATIONS FOR PEENING AND CLEANING—SAE J444a
SAE Recommended Practice*

Report of Production Division approved January 1946 and last revised by Mechanical Prestressing of Metals Division November 1976.

[This SAE Recommended Practice pertains to blast cleaning and shot peening and provides for standard cast shot and grit size numbers: It supersedes the previous SAE Recommended Practice, Shot for Peening. For shot, this number corresponds with the aperture size of the nominal screen. For grit, this number corresponds with the number of the nominal screen with the prefix G added. These screens are in accordance with the National Bureau of Standards series as given in ASTM-E 11, Specification for Sieves for Testing Purposes.

The accompanying shot and grit classifications and size designations were formulated by representatives of shot and grit suppliers, equipment manufacturers, and automotive users who constituted the Shot Peening Division of the Iron and Steel Technical Committee.]

Shot should be round and solid. When used for peening or cleaning, round, solid shot withstands breakage better than irregularity shaped or porous particles.

As used in the actual peening process, it is highly desirable that the shot be reasonably spherical and reasonably solid. It must be within the desired size limits.

Since it may be more economical for the user to me chantcally *season* the shot, the degree of control of shape and quality of shot may be established by agreement between user and shot supplier.

Testing Procedure

1. (a) A rotating and tapping type of testing machine shall be used.
   (b) The shaking speed shall be 275-295 rpm.
   (c) The taps per minute shall be 145-160, when tap ping machines are used.
2. The size of the sample shot shall be 100 g, to be ob tained from a representative quantity.
3. Screening sieves shall be in accordance with the National Bureau of Standards series as given in ASTM-E 11. They shall be of the 8 in. (203 mm) diam. eter series, of either standard 1 in. (25 mm) or **2** in. (51 mm) height.
4. The time of test shall be 5 min ± 5s for shot size up to and including U.S. Standard Screen size 35; and 10 min ± 5 s for finer screen sizes.
5. Any alternate method agreed upon between the supplier and user which gives equivalent results will be acceptable.

Grit for Cleaning – See Table 4B.

Cross References:

SAE J827 – Cast Steel Shot: for information on Corn. position and Shapes.

SAE J445 – Metallic Shot and Grit Mechanical Test. ing: for information on Shot Quality Determination.

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TABLE 5
PHYSICAL DATA ON NON-METALLIC ABRASIVES

	Hardness (Mohs Scale)	Shape	Sp. Gr.	Bulk Density (lb/cu ft)	Color	Free Silica wt. %	Degree of Dusting	Reuse
Naturally Occurring Abrasives								
SANDS								
Silica	5	Rounded	2 to 3	100	White	90+	High	Poor
Mineral	5 to 7	Rounded	3 to 4	125	Variable	<5	Medium	Good
FLINT	6.7 to 7	Angular	2 to 3	80	Lt. Grey	90+	Medium	Good
GARNET	7 to 8	Angular	4	145	Pink	Nil	Medium	Good
ZIRCON	7,5	Cubic	4.5	185	White	Nil	Low	Good
NOVACULITE	4	Angular	2.5	100	White	90+	Low	Good
By-product Abrasives								
SLAGS:								
Boiler	7	Angular	2.8	85	Black	Nil	High	Poor
Copper	8	Angular	3.3	110	Black	Nil	Low	Good
Nickel	8	Angular	2.7	85	Green	Nil	High	Poor
WALNUT SHELLS	3	Cubic	1.3	45	Brown	Nil	Low	Poor
PEACH SHELLS	3	Cubic	1.3	45	Brown	Nil	Low	Poor
CORN COBS	4.5	Angular	1.3	30	Tan	Nil	Low	Good
Manufactured Abrasives								
SILICON CARBIDE	9	Angular	3.2	105	Black	Nil	Low	Good
ALUMINUM OXIDE	8	Blocky	4.0	120	Brown	Nil	Low	Good
GIASS BEADS	5.5	Spherical	2.5	100	Clear	67	Low	Good

TABLE 6
TYPE OF MINERAL ABRASIVE RECOMMENDED FOR VARIOUS BLAST CLEANtNG OPERATIONS

	Bulk Density (lbs/cu ft)		Size Range[1]			Hardness	
	>100	<100	Coarse	Medium	Fine	Hard	Soft
New Steel	X		X			X	
Fabricated New Steel	X			X		X	
Heat-Treated Steel	X		X			X	
Heavy Steel Plate	X		X			X	
Corroded Steel	X			X		X	
Weld Scale	X			X		X	
Brush Blast		X			X		X
Repair Work	X		X			X	
Maintenance							

[1] Coarse: + #20 NBS Screen
Medium: – #25 + #45 NBS Screen
Fine: – #50 NBS Screen

TABLE 7
THRESHOLD LIMIT VALUES TLV) FOR MINERAL DUSTS[3]

Substance	Threshold Limit Value
SILICA (Crystalline):	
Quartz	300 / (% quartz + 10) mppcf[1,2]
Cristobalite	Use one-half value from quartz formula
Diatomaceous Earth	1.5 mg/cu m, Respirable dust
SILICA (Amorphous):	5 mg/cu m, Total dust (all sample sizes) 2 mg/cu m, Respirable dust (<5 microns)
SILICATES (<1% Quartz):	
Asbestos, all forms	5 fibers/cc > 5 microns in length
Graphite (Natural)	15 mppcf[1]
Mica	20 mppcf[1]
Portland Cement	30 mppcf[1]
Soapstone	20 mppcf[1]
Talc (Non-asbestiform)	20 mppcf[1]
Talc (Fibrous)	Use asbestos limit
Tremolite	See Asbestos

[1] mppcf: millions of particles per cubic foot of air, based on impinger samples counted by light-field techniques.

[2] The percentage of quartz in the formula is the amount determined from airborne samples, except in those instances in which other methods have been shown to be applicable.

[3] Reprinted from the American Conference of Governmental Industrial Hygienists booklet entitled "Threshold Limit Values for Chemical Sub-

6. Surface Profile

Surface profile is a measurement of the roughness of the surface which results from abrasive blast cleaning. The height of the profile produced on the surface Is measured from the bottoms of the lowest valleys to the tops of the highest peaks.

The profile depth (or height) is dependent upon the size, type, and hardness of the abrasive, particle velocity and angle of impact, hardness of the surface, and amount of recycling of working mixtures of grit and shot.

Therefore the maximum permissible size of the abrasive particles will depend upon the paint system thickness. The allowable "maximum height of the profile is usu. ally dependent upon the thickness of paint to be applied.

SSPC studies have shown that metallic abrasives larger than those which wiII pass through a #16 NBS screen may produce a profile which is too deep to be adequately covered with a single coat of primer. Accordingly, It Is recommended that the use of larger abrasives be avoided whenever possible. However, when heavy mill scale or rust are present, abrasives of a larger size maybe needed. In these cases two coats of shop primer should be applied Instead of the usual one coat.

Table 8 gives the range of maximum and average maximum profile heights to be expected under normal good operating conditions (wheel and nozzle). If excessively high air pressure or wheel speed is used, the profile may be significantly higher.

Profile Comparators are available from the SSPC to aid in estimating the average maximum profile of surfaces blasted with sand, steel grit, and steel shot.

A report, "Surface Profile for Anti.Corrosion Paints," is available from the SSPC describing methods of measuring profile, and relating profile to blast cleaning conditions and to coating performance.

TABLE 8
TYPICAL MAXIMUM PROFILES PRODUCED BY SOME COMMERCIAL ABRASIVE MEDIA

Abrasive	Maximum Particle Size NBS Screen No.	Typical Profile Height (mil Maximum	Av. Maximum
STEEL ABRASIVES[1]:			
Shot S230	– #18 + #20	2.9 ± 0.2	2.2 ± 0.3
Shot S280	– #16 + #18	3.5 ± 0.3	2.5 ± 0.4
Shot S330	– #14 + #16	3.8 ± 0.4	2.8 ± 0.5
Shot S390	– #12 + #14	4.6 ± 0.5	3.5 ± 0.7
Grit G50	– #25 + #30	2.2 ± 0.3	1.6 ± 0.3
Grit G40	– #18 + #20	3.4 ± 0.4	2.4 ± 0.5
Grit G25	– #16 + #18	4.6 ± 0.5	3.1 ± 0.7
Grit G14	– #10 + #12	6.5 ± 0.8	5.1 ± 0.9
MINERAL ABRASIVES:			
Flint Shot	Medium-Fine	3.5 ± 0.4	2.7 ± 0.4
Silica Sand	Medium	4.0 ± 0.5	2.9 ± 0.4
Boiler Slag	Medium	4.6 ± 0.5	3.1 ± 0.5
Boiler Slag	Coarse	6.0 ± 0.7	3.7 ± 0.7
Heavy Mineral Sand	Medium-Fine	3.4 ± 0.4	2.6 ± 0.4

[1] Profile heights shown for steel abrasives were produced with conditioned abrasive of stabilized operating mixes in recirculating abrasive blast cleaning machines. Profile heights produced by new abrasives having screen analyses shown in Tables 4 and 4B will be appreciably higher

Cast Steel Shot: Hardness 40 to 50 Rockwell C

Cast Steel Grit: Hardness 55 to 60 Rockwell C

7. Visual Standards

Note that visual standards, when used in conjunction with SSPC specifications, give only an approximation of the final surface condition. It is cautioned, therefore, that any visual standards should be considered a supplement to, and not a substitute for, surface preparation specifications. The use of the visual standards in conjunction with SSPC specifications is required only when they are specified in the procurement document covering the work. It Is recommended, however, that the use of visual standards be made mandatory in the procurement document.

7.1 SSPC-Vis 1, "Pictorial Surface Preparation Standards for Painting Steel Surf aces," are available as a separate publication of color photographs. They were orig. inaily prepared by the Swedish Standards Institute Corro. sion Committee, supplemented by the SSPC, and approved by the American Society for Testing and Materials (ASTM), Swedish Standards Institution (S1S), Danish Standards Association, Standards Association of Australia, Jugo" slovenski Zavod Za Standardizaciju, European Committee of Paint and Printing Ink Manufacturers' Association, American National Standards institute (ANSI), National Association of Corrosion Engineers (NACE), and the Steel Structures Painting Council (SSPC). They may be obtained from the SSPC, ASTM, or SIS.

The color photographs in the pictorial standard repre. sent four rustgrades of hot-rolled structural steel surfaces, described as A, B, C, and D in Section 3.1. Approximate reproductions of some photographs are included as part of the Guide to SSPC-Vis 1. The SSPC.Vis 1 standard book also Includes two degrees of thoroughness of hand clean. ing and three or four degrees of blast cleaning for each of these four rustgrades. The SSPC-Vis 1 photographs depicting the grades of surface preparation prior to painting are cross-referenced to the SSPC surface preparation specifi. cations in the Guide to SSPC-Vis 1.

7.2 NACE STANDARDS TM.01.70 AND TM.01.75: The National Association of Corrosion Engineers has devel. oped visual standards for evaluating the degree of cleanliness of steel blast cleaned with sand, steel grit, or steel shot. Steel test panels have been individually cleaned to each of the four degrees of blast cleaning and sealed with plastic to prevent rusting. Both NACE and SSPC have been careful to see that NACE Grades 1 (White), 2 (Near-White), 3 (Commercial), and 4 (Brush. Off), and their definitions cor. respond closely to those of SSPC.SP 5, 10,6, and 7 respectively.

7.3 OTHER PHOTOGRAPHIC STANDARDS: The American Rust Standard System, Inc., has issued photo graphs Illustrating 24 degrees of rustiness in uncleaned, hot-rolled steel.

The Production Technical Society (Japan) has printed color illustrations of wash primed and zinc.rich primed steel before and after weathering and re-cleaning. The photographs of the Shipbuilding Association of Japan Il. Iustrate the appearance of painted, unpainted, welded,

and flame-cut steel before and after various degrees of damage or weathering.

The Society of Naval Architects and Marine Engineers (SNAME) has issued a booklet of photographs illustrating typical appearances of painted and unpainted steel before and after being blast cleaned to grades "in between" SSPC-SP 5, 6, 7, and 10.

The State of Maryland pictorial standards for shot blasting contain two photographs representing the surface conditions of SSPC-SP 6 (Commercial) and SSPC-SP 10 (Near-White) blast cleaning. (Steel rusted beyond SSPC-Vis 1, Rustgrade C is deemed unacceptable.)

7.4 PROJECT PREPARED STANDARDS Prepared steel will often appear differently from the photographic standards due to variations in initial surface conditions, abrasives being used, and so forth. Because of difficulties in comparisons, it is sometimes recommended that the contractor provide blast cleaned samples representative of the steel to be blasted which, by mutual agreement of the owner and the contractor, are representative of the required surface cleanliness and appearance. Suggested dimension of the reference steel panels are 6" x 6" x 3/16" minimum (approximately 15 cm x 15 cm x 0.5 cm). The blast cleaned panels should be completely protected from corrosion and contamination, and maintained as visual reference standards for the duration of the project.

8. Rust Back

Rust back occurs when freshly exposed bare steel Is exposed to conditions of high humidity, moisture, or a corrosive atmosphere. The time interval between blast *cleaning* and rust back will vary greatly (from minutes to weeks) from one environment to another. Because of this factor, timeliness of inspection is of great importance. Inspection must be coordinated with the fabricators' schedule of operation in such a way as to avoid delay. Acceptance of the prepared surface must be made prior to application of the prime coat, because the degree of surface preparation cannot be readily verified after painting. To avoid potential deterioration of the surface, It must be assumed that surface preparation is accepted unless Inspected and rejetted prior to scheduled application of prime coat.

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.

Moisture condenses on any surface that is colder than the dew point of the surrounding air. It is therefore recommended that dry blast cleaning should not be conducted when the steel surface is less than 5 F˚(3 C˚) above the dew point.

Excessive weathering or exposure of steel to chemical fumes such as chlorides and sulfates prior to blast cleaning should be avoided since pitting of the steel may Increase cleaning costs and makes removal of contaminants difficult. After blast cleaning, even slight residues of chlorides, sulfates, or other electrolytes on the steel surface may be harmful, and for some coatings, may cause premature coating failure.

9. Inhibitors

Steel that Is wet blast cleaned will rust rapidly as a result of the water. It is essential that Inhlbltors be added to the water or applied to the surface immediately after blast cleaning to temporarily prevent rust formation. The coating should then be applied before any rusting is visible on the surface.

A suitable inhibitive treatment for blast cleaned sur. faces is water containing 0.32% of sodium nitrite and 1.28% by weight of secondary ammonium phosphate (dibasic] alternatives are water containing about 0.2% by weight of chromic acid or sodium chromate or sodium bichromate or potassium dichromate. NOTE: If solutions containing either chromates or dichromates are used, precautions should be taken to protect personnel from hazards resulting from breathing spray or contacting, the solution.

10. Film Thickness

It is essential that ample coating be applied after blast cleaning to adequately cover and protect the peaks of the surface profile. Thus, the depth of the surface profile should be considered in determining the amount of coating to be applied. For higher profiles a larger Coating thickness should be specified. To assure that coating thicknesses are properly measured from the peaks *of* the profile, refer to SSPC.PA 2, "Measurement of Dry Paint Thickness with Magnetic Gages."

11. Summary of SSPC Surface Preparation Specifications

Although these, specifications are primarily intended for heavy metal or plate, most are also suitable for Iight weight or thin section metal. Obviously, caution must be exercised when using methods such as blast cleaning on metal of thin section since damage by warping or from excessive peening of the surface may occur. Occasions will arise where these specifications will not result in the type of cleaning desired. In such cases, the surface preparation specifications may be modified by the user to obtain the result desired. Regardless of which methods are used, adjacent equipment, pre-finished items, or surfaces that could be damaged from the method of surface preparation must be protected.

Occasionally in maintenance painting the previous paint is incompatible with the new paint. Under these circumstances all paint, regardless of condition, will have to be removed. A minimum of SSPC.SP 6, "Commercial Blast Cleaning" is usually necessary.

Volume 1 of the Steel Structures Painting Manual devotes several chapters to mechanical surface prepara-

necessary failures or to avoid unnecessarily stringent specifications for the preparation of surfaces which will be exposed In mild environments. Care in hand cleaning is also especially important if the prime coat is to be applied by spray.

The hand cleaning specification requires that oil and grease, along with any salts, be removed prior to hand tool cleaning as specified In SSPC-SP 1, "Solvent Cleaning." On welded work, particular care should be taken to remove as much welding flux, slag, and fume deposit as is possible since these are notorious In promoting paint failure on welded joints. All loose matter should be removed from the surface prior to painting; blowing It off with clean, dry, oil-free compressed air; brushing; or vacuum cleaning are satisfactory methods.

11.2.1 Loose Rust: Determination of the degree of cleaning required to comply with this specification is often very difficult. The problem is in establishing whether a residue is "adherent" or "loose." The specification considers the residue adherent if it cannot be Iifted with a dull putty knife, a somewhat subjective criterion.

One possible solution is to establish a standard of cleaning through use of a specified cleaning procedure in which the type of brush, force, speed, etc., are stipulated. The surface for the standard (or the control) should be a flat portion of the surface actually to be cleaned.

It is emphasized that this establishes a standard of cleanliness, *but not a production rate.* As long as the surface is cleaned as well as that in the standard cleaning, the actual production rate is not in question. The standard Is of value in case of any difference of opinion as to whether or not the surface has been properly cleaned.

11.2.2 Visual Standards: If mutually agreed upon, SSPC-VIS 1 or other visual references may be used to supplement the cleaning criteria of this specification. For par-Ilally rusted mill scale, for completely rusted mill scale, or for completely rusted and pitted surfaces, the appearance of the surface after hand tool cleaning should correspond to pictorial standards B St 2, C St 2, or D St 2 of SSPC-VIS 1. Other cleaning specifications and visual standards are described In Sections 7 and 12 of this Commentary.

11.5 SSPC.SP 5, "WHITE METAL BLAST CLEANING": White Metal Blast Cleaning is generally used for exposures In very corrosive atmospheres and for immersion service where the highest degree of cleaning Is required and a high surface preparation cost is warranted.

Blast cleaning to white metal wiII result In high performance of the paint systems due to the complete removal of all rust, mill scale, and foreign matter or contaminants from the surface, In ordinary atmospheres and general use white metal is seldom warranted,

The use of this grade of blast cleaning without rust back is particularly difficult in the environments where it is most needed as a preparation for painting; for example, in humid chemical environments. White Metal Blast Cleaning should be conducted at a time when no contamination or rusting can occur, and when prompt painting is possible. A good rule Is that no more surface should be prepared for painting than can be coated the same day.

When this specification is used in maintenance paint. ing, specific instructions should be given on the extent of surface to be blast cleaned in accordance with this specl-flcatlon and the amount of spot cleaning required. In main tenance painting it is not ordinarily intended that sound, adherent old paint be removed unless it is excessively thick, inflexible, or incompatible with the specified paint system. SSPC-PA 1, "Shop, Field, and Maintenance Painting," and SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," cover additional maintenance painting procedures.

11.5.1 Visual Standards: If mutually agreed upon, SSPC-Vis 1 or other visual references may be used to supplement the cleaning criteria of this specification. For partially rusted mill scale, for completely rusted mill scale, or for completely rusted and pitted surfaces, the appearance of the surface after White Metal Blast Cleaning should correspond to pictorial standards A Sa 3, B Sa 3, C Sa 3, or D Sa 3 of SSPC-Vis 1. The color or hue of the cleaned surface may be affected by the nature of the steel, the abrasives, and by previous painting. Other cleaning specifications and visual standards are described in Sections 7 and 12 of this Commentary.

11.6 SSPC-sP 6, "COMMERCIAL BLAST CLEANING": Commercial Blast Cleaning should be employed for all general purposes where a high, but not perfect, degree of blast cleaning is required. It will remove all rust, mill scale, and other detrimental matter from the surface, but wIII permit a great deal of staining from rust or mill scale to re main. The surface wiII not necessarily be uniform In color, nor will all surfaces be uniformly clean. If the cleaning done according to this specification is likely to result In a surface unsatisfactoty for severe service, then Near-White Blast Cleaning or White Metal Blast Cleaning should be specified. The advantage of Commercial Blast Cleaning lies in the lower cost for satisfactory surface preparation for the majority of cases where blast cleaning is believed to be necessary.

When this specification is used in maintenance painting, specific Instructions should be given on the extent of surface to be blast cleaned in accordance with this specification and the amount of spot cleaning required. In maintenance painting it is not ordinarily intended that sound, adherent old paint be removed unless it is excessively thick, inflexible, or incompatible with the specified paint system. SSPC.PA 1, "Shop, Field, and Maintenance Painting,;' and SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," cover additional maintenance painting procedures.

11.6.1 Visual Standards: If mutually agreed upon, SSPC-WS 1 or other visual references may be used to supplement the cleaning criteria of this specification. For partially rusted mill scale, for completely rusted mill scale, or for completely rusted and pitted surfaces, the appearance of the surface after Commercial Blast Cleaning should correspond to pictorial standards C Sa 2 or D Sa 2 of SSPC.

Vis 1. NOTE The current B Sa 2 photograph (1982) is not representative of Commercial Blast Cleaning. Also note that a photograph Is not available for a commercial blast over an intact mill-scale.bearing surface, as this is considered impractical. The color or hue of the cleaned surface may be affected by the nature of the steel, the abrasives, and by previous painting. Other cleaning specifications and visual standards are described in Sections 7 and 12 of this Commentary.

11.6.2 As with all SSPC specifications, the referenced standard In effect on the date of invitation to bid shall gov. ern unless otherwise specified.

11.6.3 Besides a change in format, the major difference between this 1982 revision of SSPC-SP 6 and the eariler (1963) version is a change In the wording but not in the meaning of the cleaning requirement. Section 2.2 of the earlier version contained the words "each square inch." The present revision in Section 2.1 simply refers to "surface."

If the specifier prefers the cleaning description of the earlier version the specification should be Invoked as follows:

> "SSPC.SP 6, 'Commmercial Blast Cleaning' except that the words '33°A of the surface' shall be changed to read '33% of each square Inch of surface' in the second sentence of Section 2.1."

11.10 SSPC.SP 10, "NEAR.WHfTE BLAST CLEANING": In many exposures involving a combination of high humidity, chemical atmosphere, marine, or other corrosive environment, the use of White Metal Blast Cleaning was found to be overly expensive due to the disproportionately large amount of work required to remove the last vestiges of streaks and shadows. The U.S. engineers, naval shipyards, highway departments, and the SSPC have found that there are many applications in which these traces can be tolerated without appreciable loss in coating life. Therefore the need for a grade of blast cleaning beyond that of commercial but less than White-Metai Blast Cleaning was demonstrated. This Near-White Blast Cleaning specification was developed to fill this need.

Near-White Blast Cleaning should be employed for all general purposes where a high degree of blast cleaning is required. it will remove all rust, mill scale, and other detrimental matter from the surface but permits streaks and stains to remain. The surface will not necessarily be cornpletely uniform in color, nor will all surfaces be uniformly clean. However, It is explicit in this specification that shadows, streaks, or discolorations, if any, be slight and be distributed uniformly over the surface - not concentrated in spots or areas.

The advantage of Near-White Blast Cleaning lies in "' the lower cost for surface preparation that is satisfactory for all but the most severe service conditions. Depending upon the initial condition of the new or previously painted steel, it has been variously estimated that Near-White Blast Cleaning can be carried out at a cost of 10.35% less than that of White Metal Blast Cleaning. These numbers are estimates only and will not hold true in all cases.

The verbal description, calling for at least 95% of the ' surface being equivalent to White Metal Blast Cleaning, is based upon a iarge number of visual observations and a limited number of light reflectivity measurements. it is hoped that the amount of surface impurity can be quan tified by specific measurement technique, but efforts to '" date have been unsuccessful except on a laboratory basis. it Is believed, however, that a visual estimate of the amount of residuals can be agreed upon between owner and contractor.

When this specifica..on is used in maintenance paint. ing, specific instructions should be given on the extent of surface to be blast cleaned In accordance with this specification and the amount of spot cleaning required. in main tenance painting it Is not ordinarily intended that sound, adherent old paint be removed unless it is excessively thick, infiexibie, or Incompatible with the specified paint system. SSPC.PA 1, "Shop, Field and Maintenance Paint. ing," and SSPC.PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," cover additional maintenance painting procedures.

11.10.1 Visual Standards: If mutually agreed upon, SSPC.Vis 1 or other visual references may be used in place to supplement the cleaning criteria of this specification. For partially rusted mill scale, for completely rusted mill

scale, or for completely rusted and pitted surfaces, the appearance of the surface after Near-White Blast Cleaning should correspond to pictorial standards A Sa 2-1/2, B Sa 2.1/2, C Sa 2.1/2, or D Sa 2.1/2 of SSPC-Vis 1. The color or hue of the cleaned surface may be affected by the nature of the steel, abrasives used, and by previous painting. Other cleaning specifications and visual standards are described in Sections 7 and 12 of this Commentary.

11.10.2 As with all SSPC specifications, the referenced standards in effect on the date of invitation to bid shall govern unless otherwise specified.

11.10.3 Besides a change in format, the major difference between this 1982 revision of SSPC-SP 10 and the earlier (1963) version is a change in the wording but not in the meaning of the cleaning requirement. Section 2.2 of the earlier version contained the words "each square inch." The present revision in Section 2.1 simply refers to "surf ace."

If the specifier prefers the cleaning description of the earlier version the specification should be invoked as follows:

> "'SSPC.SP 10, 'Near-White Blast Cleaning' – except that the words '5% of the surface' shall be changed to read '5% of each square inch of surface' in the second sentence of Section 2.1."

12. Other Cleaning Specifications

The recommendations, specifications, and guides of a number of other associations reference the Steel Structures Painting Council Surface Preparation Specifications, including: American Association of State Highway and Transportation Officials (AASHTO); American Institute of Steel Construction (AISC); American Iron and Steel institute (AISI); American Petroleum Institute (API); American Railway Bridge and Building Association (ARBBA); American Water Works Association (AWWA); Canadian institute of Steel Construction (CISC); Painting and Decorating Contractors of America (PDCA); Steel Plate Fabricators Association (SPFA); and the Texas Structural Steel Institute (TSSI). They are also used by many state highway departments and other federal, state, and local agencies.

The National Association of Corrosion Engineers (NACE) has cooperated closely with the SSPC and in the NACE standards TM-01-70 and TM-W-75 has adopted definitions essentially the same as those given in the definition sections of the four corresponding SSPC surface preparation specifications. Visual standard panels are Included In TM-01-70 and TM-01.75 which show each of the four grades of cleaning on surfaces which have been air blasted with sand and centrifugal wheel blasted with cast steel shot and grit.

Governmental agencies have been active in preparing good surface preparation specifications, but most of these deal with thin metal and do not particularly apply to structures. The Corps of Engineers Civil Works Division has issued CW 09940, "Guide Specifications for Painting Hydraulic Structures and Appurtenant Works." This specification covers the cleaning and treating of structural steel as well as the application of paint and the paints to be used. It makes use of the SSPC surface preparation specifications.

Federal Specification TT.C-490, "Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings," covers various types of surface preparation and pretreatments.

U.S. Military Specification MIL-T-704, "'Treatment and Painting (for Construction and Engineering Equipment)," gives detailed instructions for surface preparation of steel, corrosion-resistant steel, zinc, aluminum and aluminum alloys, magnesium alloys, and wood.

For internal use, the U.S. Department of the Navy, Naval Sea Systems Command, has prepared Chapter 631, "Preservation of Ships in Service (Surface Preparation and Painting) NAVSEA.S9086-VD.STM-OOOC H-631," which includes surface preparation specifications in addition to painting specifications and paint systems. Detailed specifications for pickling are included.

The British Standards Institution has adopted three grades of blast cleaning roughly equivalent to SSPC.SP 5, 6, and 10. The Swedish Standards Institution has adopted a set of photographs S1S 055900 upon which SSPC-Vis 1 is based. Several of these photographs were provided by the SSPC.

The International Organization for Standardization (ISO) is planning a set of surface preparation definitions and photographic references.

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