# Systems and Specifications

## SSPC Painting Manual Volume 2

## 2008 Edition



# SSPC PAINTING MANUAL

## Volume 2
# SYSTEMS AND SPECIFICATIONS
## Eighth Edition

*Editor*
**Janet Rex**

SSPC: The Society for Protective Coatings
40 24th Street, 6th Floor • Pittsburgh, PA 15222

Provided by : www.spic.ir Licensee: NISOC Library

**DISCLAIMER**

These specifications, guides, and recommendations have been developed in accordance with voluntary consensus procedures by SSPC Advisory Committees and are believed to represent good current practice. They are monitored and revised as practices improve, and suggestions for revision are welcome. Other methods, materials, and specifications may be equally effective or superior. SSPC is not responsible for the application, interpretation, or administration of these specifications, guides and recommendations. Moreover, SSPC does not issue interpretations of its specifications, guides or recommendations; and no person is authorized to issue an interpretation of an SSPC specification, guide, or recommendation on behalf of SSPC. SSPC specifically disclaims responsibility for the use or misuse of these specifications, guides and recommendations. The supplying of details about patented formulations, treatments, or processes is not to be regarded as conveying any right or permitting the user of this manual to use or sell any patented invention. When it is known that the subject matter of the text is covered by patent, such patents are reflected in the text.

Copyright 2000 by SSPC: The Society for Protective Coatings

All Rights Reserved

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

Eighth Edition

ISBN 1-889060-50-X
SSPC 00-10

Provided by : www.spic.ir Licensee: NISOC Library

**©2000**

This CD-ROM of the SSPC Painting Manual, Volume 2, was produced for The Society for Protective Coatings (SSPC) by *omnipress*. The product contains Adobe Acrobat® software with omnipro-CD™ structuring, formatting and design features. Permission to print and distribute content from this product must be through the approval of the SSPC. Duplication or replication of this CD-ROM, or copying its instructions and design for use on future CD-ROMs or other products is absolutely prohibited without written permission from the SSPC, *omnipress* and Adobe (all three). Adobe®, Acrobat® and the Acrobat logo are trademarks of Adobe Systems Incorporated or its subsidiaries and may be registered in certain jurisdictions.

*omnipress*
omnipro-CD™

Adobe Acrobat®

Provided by : www.spic.ir Licensee: NISOC Library

# Preface to Volume 2, 8th Edition

This edition of Volume 2 of the SSPC Painting Manual contains a number of significant changes. There are now eleven chapters instead of eight. The commentaries on surface preparation (SP COM), painting systems (PS COM), and paints (Paint COM) have been updated. Two new commentaries have been added: a paint application commentary (PA COM) in Chapter 7 and a qualification procedures commentary (QP COM) in Chapter 8.

In Chapter 2, SSPC-VIS 2, "Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces" has undergone a major revision and there is now a joint visual standard SSPC-VIS 4/NACE No. 7, "Visual Reference Photographs for Steel Cleaned by Water Jetting." Minor revisions have been made to four joint surface preparation standards SSPC-SP 5, SP 10, SP 6, and SP 7. Three new joint surface preparation standards are in the eighth edition: SSPC-SP 12/NACE No. 5, "Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating," SSPC-SP 13/NACE No. 6, "Surface Preparation of Concrete," and SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."

Chapter 3 is comprised of two joint technology reports. SSPC-TR 2/NACE 6G198, "Wet Abrasive Blast Cleaning," is new in the eighth edition.

The three SSPC abrasive specifications comprise Chapter 4. SSPC-AB 2, "Cleanliness of Recycled Ferrous Metallic Abrasives" and SSPC-AB 3, "Newly Manufactured or Re-Manufactured Steel Abrasives" are new in this edition.

Three new documents are in Chapter 5. The thermal spray guide has been replaced by SSPC-CS 23.00(I), "Interim Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel." This has been issued as an interim specification pending formal approval of the other two joint sponsoring organizations, AWS and NACE International. The two other new documents in this chapter are SSPC-PS 26.00, "Aluminum Pigmented Epoxy Painting System Materials Specification, Performance-Based; Type I, for Use over Blast Cleaned Steel; Type II, for Use over Hand Cleaned Steel" and SSPC-PS 27.00, "Alkyd Painting System Materials Specification, Performance-Based."

There are six new or revised paint specifications in Chapter 6. SSPC-Paint 15, "Steel Joist Shop Paint" has been revised to be more performance based. Two new variations of SSPC-Paint 25 have been added: SSPC-Paint 25, "Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel" and SSPC-Paint 25 BCS, "Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Blast Cleaned Steel." The other three new paints in this edition are SSPC-Paint 34, "Water-Borne Epoxy Topcoat for Steel Surfaces," SSPC-Paint 35, "Medium Oil Alkyd Primer (Air Dry/Low Bake)," and SSPC-Paint 36, "Two-Component Weatherable Aliphatic Polyurethane Topcoat, Performance-Based."

Chapter 7 on paint application contains revised versions of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel" and SSPC-PA 2, "Measurement of Dry Coating Thickness With Magnetic Gages."

A commentary (QP COM) has been written for Chapter 8, Qualification Procedures. SSPC-QP 1, "Standard Procedure for Evaluating Qualifications of Painting Contractors (Field Application to Complex Industrial Structures)," SSPC-QP 2, "Standard Procedure for the Qualification of Painting Contractors (Field Removal of Hazardous Coatings from Complex Structures) and SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators" have been revised. Two new qualification procedures are included in the eighth edition: SSPC-QP 4, "Standard Procedure for Evaluating Qualification of Contractors Disturbing Hazardous Paint During Demolition and Repair Work" and SSPC-QP 5, "Standard Procedure for Evaluating Qualifications of Coating and Lining Inspection Companies."

Guides other than painting system guides (PS Guides) or paint application guides (PA Guides) have been grouped together in Chapter 9. Five of the eight guides here are new in this edition of Volume 2: SSPC-Guide 6, "Guide for Containing Debris Generated During Paint Removal Operations," SSPC-Guide 11, "Guide for Coating Concrete," SSPC-Guide 12, "Guide for the Illumination of Industrial Painting Projects," SSPC-Guide 13, "Guide for the Identification and Use of Industrial Coating Material in Computerized Product Databases," and SSPC-Guide 14,

Provided by : www.spic.ir Licensee: NISOC Library

"Guide for Repair of Imperfections in Galvanized or Inorganic Zinc-Coated Steel Using Organic Zinc-Rich Coating."

A new kind of SSPC document is the technology update (TU). A TU is a consensus SSPC document prepared by a committee that describes and assesses a new material, procedure, concept, method, or other area of technology. Technology updates are considered "fast track" documents and skip some steps in the standards approval process. A TU differs from other types of SSPC standards in that it is not suitable for referencing in a specification or procurement document. It differs from a technical article in a journal in that it represents a consensus of balanced interests, not a single author's viewpoint.

Chapter 10 contains all seven SSPC technology updates, which address a variety of topics. These are: SSPC-TU 1, "Surface-Tolerant Coatings for Steel," SSPC-TU 2, "Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment," SSPC-TU 3, "Overcoating," SSPC-TU 4, "Field Methods for Retrieval and Analysis of Soluble Salts on Substrates," SSPC-TU 5, "Accelerated Testing of Industrial Protective Coatings," SSPC-TU 6, "Chemical Stripping of Organic Coatings from Steel Surfaces," and SSPC-TU 7 "Conducting Ambient Air, Soil, and Water Sampling During Surface Preparation and Paint Disturbance Activities."

Chapter 11 contains the single document on a method of preparing test panels, SSPC-ME 1, "Uncontaminated Rusted Steel."

The Appendix contains a list of organizations along with their address, phone and fax number, and web site address. It also includes a list of all standards and specifications referenced in Volume 2.

For the first time, Volume 2 contains documents on the coating of concrete. These documents are: SSPC-SP 13, "Surface Preparation of Concrete" in Chapter 1; SSPC-Guide 11, "Guide for Coating Concrete" in Chapter 9; and SSPC-TU 2, "Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment" in Chapter 10.

The most significant editorial changes occurred in Chapter 5 on painting systems and in Chapter 6 on paints. Many federal specifications have been canceled or replaced with commercial item descriptions. Some ASTM specifications have also been discontinued. When possible, a canceled specification was replaced with its active equivalent. The substance of each specification was not altered.

While it is impossible to name all of the contributors to the new standards in this edition, a few individuals may be singled out for their leadership of SSPC committees. Members of the SSPC Standards Review Committee include William M. Medford (Chair), Alfred D. Beitelman, Harold Clem, Allan DeLange, John Hauck, Dr. Mary McKnight, John Montle, Tim Race, Mark Schilling, Kenneth A. Trimber, and Bala Viswanath. SSPC Group Committee Chairs include Daniel P. Adley, Richard Drisko, Stephen G. Pinney, Tim Race, Kenneth A. Trimber, and Daniel A. Zarate. SSPC/NACE Joint Task Group Chairs who have developed standards included in this volume are Dr. Lydia M. Frenzel, Frederick S. Gelfant, and Kenneth A. Trimber.

I would also like to thank the SSPC staff for this revision of Volume 2, especially Dr. Bernard Appleman, my predecessor as Executive Director; Aimee Beggs, Standards Development Specialist; Michael Damiano, Director of Product Development; Russell Davison, Marketing Specialist; Janet Rex, Technical Information Developer; Marge Sroka, Information Resources Specialist; Tonni Tilstra, Technical Materials Specialist; and Raymond Weaver, Technical Advisor.

The standards in Volume 2 are the product of years of consensus building and teamwork. I would also like to thank those individuals, too numerous to name here, who donated their valuable time and expertise to developing standards for our industry.

William L. Shoup
Executive Director

Provided by : www.spic.ir Licensee: NISOC Library

# Table of Contents

To use this Table of Contents: scroll down or use the bookmarks in the navigation pane at left to move to a different location in this index. Click on a **blue document title** to view that document. To return to this index after viewing a document, click the "Previous Menu" bookmark in the navigation pane.

Some of the material on this CD-ROM was created from scanning the author's paper originals, while other content was converted from digital files. Viewing of the text and graphics and the ease of readability will depend largely on content requiring scanning and the quality and/or consistency of the material being scanned.


**CHAPTER 1—HOW TO USE SSPC SPECIFICATIONS AND GUIDES**

CHAPTER 2—SURFACE PREPARATION STANDARDS, GUIDES, AND SPECIFICATIONS

| | |
|---|---|
| SSPC-SP COM | **Surface Preparation Commentary** |
| Guide to SSPC-VIS 1-89 | **Visual Standard for Abrasive Blast Cleaned Steel** |
| Guide to SSPC-VIS 2 | **Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces** |
| Guide to SSPC-VIS 3 | **Visual Standard for Power- and Hand-Tool Cleaned Steel** |
| Guide to SSPC-VIS 4/NACE No. 7 | **Visual Reference Photographs for Steel Cleaned by Water Jetting** |
| SSPC-SP 1 | **Solvent Cleaning** |
| SSPC-SP 2 | **Hand Tool Cleaning** |
| SSPC-SP 3 | **Power Tool Cleaning** |
| SSPC-SP 5/NACE No. 1 | **White Metal Blast Cleaning** |
| SSPC-SP 6/NACE No. 3 | **Commercial Blast Cleaning** |
| SSPC-SP 7/NACE No. 4 | **Brush-Off Blast Cleaning** |
| SSPC-SP 8 | **Pickling** |
| SSPC-SP 10/NACE No. 2 | **Near-White Blast Cleaning** |
| SSPC-SP 11 | **Power Tool Cleaning to Bare Metal** |
| SSPC-SP 12/NACE No. 5 | **Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating** |
| SSPC-SP 13/NACE No. 6 | **Surface Preparation of Concrete** |
| SSPC-SP 14/NACE No. 8 | **Industrial Blast Cleaning** |

CHAPTER 3—SSPC/NACE JOINT TECHNOLOGY REPORTS

| | |
|---|---|
| SSPC-TR 1/NACE 6G194 | **Thermal Precleaning** |
| SSPC-TR 2/NACE 6G198 | **Wet Abrasive Blast Cleaning** |

CHAPTER 4—ABRASIVE SPECIFICATIONS

| | |
|---|---|
| SSPC-AB 1 | **Mineral and Slag Abrasives** |
| SSPC-AB 2 | **Cleanliness of Recycled Ferrous Metallic Abrasives** |
| SSPC-AB 3 | **Newly Manufactured or Re-Manufactured Steel Abrasives** |

CHAPTER 5—PAINTING AND COATING SYSTEMS GUIDES AND SPECIFICATIONS

| | |
|---|---|
| SSPC-PS COM | **Commentary on Painting Systems** |
| SSPC-PS Guide 1.00 | **Guide to Selecting Oil Base Painting Systems** |
| SSPC-PS 1.09 | **Three-Coat Oil Base Zinc Oxide Painting System (Without Lead or Chromate Pigment)** |
| SSPC-PS 1.10 | **Four-Coat Oil Base Zinc Oxide Painting System (Without Lead or Chromate Pigment)** |


Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| SSPC-PS 1.12 | **Three-Coat Oil Base Zinc Chromate Painting System** |
| SSPC-PS 1.13 | **One-Coat Oil Base Slow Drying Maintenance Painting System (Without Lead or Chromate Pigments)** |
| SSPC-PS Guide 2.00 | **Guide for Selecting Alkyd Painting Systems** |
| SSPC-PS Guide 3.00 | **Guide for Selecting Phenolic Painting Systems** |
| SSPC-PS Guide 4.00 | **Guide for Selecting Vinyl Painting Systems** |
| SSPC-PS 4.02 | **Four-Coat Vinyl Painting System** |
| SSPC-PS 4.04 | **Four-Coat White or Colored Vinyl Painting System (For Fresh Water, Chemical, and Corrosive Environments)** |
| SSPC-PS Guide 7.00 | **Guide for Selecting One-Coat Shop Painting Systems** |
| SSPC-PS Guide 8.00 | **Guide to Topcoating Zinc-Rich Primers** |
| SSPC-PS 9.01 | **Cold-Applied Asphalt Mastic Painting System with Extra-Thick Film** |
| SSPC-PS 10.01 | **Hot-Applied Coal Tar Enamel Painting System** |
| SSPC-PS 10.02 | **Cold-Applied Coal Tar Mastic Painting System** |
| SSPC-PS 11.01 | **Black (or Dark Red) Coal Tar Epoxy-Polyamide Painting System** |
| SSPC-PS Guide 12.00 | **Guide for Selecting Zinc-Rich Painting Systems** |
| SSPC-PS 12.01 | **One-Coat Zinc-Rich Painting System** |
| SSPC-PS 13.01 | **Epoxy Polyamide Painting System** |
| SSPC-PS 14.01 | **Steel Joist Shop Painting System** |
| SSPC-PS Guide 15.00 | **Guide for Selecting Chlorinated Rubber Painting Systems** |
| SSPC-PS 15.01 | **Chlorinated Rubber Painting System for Salt Water Immersion** |
| SSPC-PS 15.02 | **Chlorinated Rubber Painting System for Fresh Water Immersion** |
| SSPC-PS 15.03 | **Chlorinated Rubber Painting System for Marine and Industrial Environments** |
| SSPC-PS 15.04 | **Chlorinated Rubber Painting System for Field Application Over a Shop-Applied Solvent Base Inorganic Zinc-Rich Primer** |
| SSPC-PS 16.01 | **Silicone Alkyd Painting System for New Steel** |
| SSPC-PS Guide 17.00 | **Guide for Selecting Urethane Painting Systems** |
| SSPC-PS 18.01 | **Three-Coat Latex Painting System** |
| SSPC-PS Guide 19.00 | **Guide for Selecting Painting Systems for Ship Bottoms** |
| SSPC-PS Guide 20.00 | **Guide for Selecting Painting Systems for Boottoppings** |
| SSPC-PS Guide 21.00 | **Guide for Selecting Painting Systems for Topsides** |
| SSPC-PS Guide 22.00 | **Guide for Selecting One-Coat Preconstruction or Prefabrication Painting Systems** |
| SSPC-CS Guide 23.00 (I) | **Interim Specification for the Application of Thermal Spray Coatings(Metallizing) of Aluminum, Zinc and Their Alloys and Composites for the Corrosion Protection of Steel** |
| SSPC-PS 24.00 | **Latex Painting System for Industrial and Marine Atmospheres, Performance-Based** |
| SSPC-PS 26.00 | **Aluminum Pigmented Epoxy Coating System Materials Specification, Performance-Based** |
| SSPC-PS 27.00 | **Alkyd Coating System Materials Specification, Performance-Based** |

## CHAPTER 6—PAINT AND COATING STANDARDS AND SPECIFICATIONS

| | |
|---|---|
| SSPC-Paint COM | **Commentary on Paint Specifications** |
| SSPC-Paint 5 | **Zinc Dust, Zinc Oxide, and Phenolic Varnish Paint** |
| SSPC-Paint 8 | **Aluminum Vinyl Paint** |
| SSPC-Paint 9 | **White (or Colored) Vinyl Paint** |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| SSPC-Paint 11 | **Red Iron Oxide, Zinc Chromate, Raw Linseed Oil, and Alkyd Paint** |
| SSPC-Paint 12 | **Cold-Applied Asphalt Mastic (Extra Thick Film)** |
| SSPC-Paint 15 | **Steel Joist Shop Primer** |
| SSPC-Paint 16 | **Coal Tar Epoxy Polyamide Black (or Dark Red) Paint** |
| SSPC-Paint 17 | **Chlorinated Rubber Inhibitive Primer** |
| SSPC-Paint 18 | **Chlorinated Rubber Intermediate Coat Paint** |
| SSPC-Paint 19 | **Chlorinated Rubber Topcoat Paint** |
| SSPC-Paint 20 | **Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic")** |
| SSPC-Paint 21 | **White or Colored Silicone Alkyd Paint** |
| SSPC-Paint 22 | **Epoxy Polyamide Paints (Primer, Intermediate, and Topcoat)** |
| SSPC-Paint 23 | **Latex Primer for Steel Surfaces** |
| SSPC-Paint 24 | **Latex Semigloss Exterior Topcoat** |
| SSPC-Paint 25 | **Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel** |
| SSPC-Paint 25 BCS | **Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Blast Cleaned Steel** |
| SSPC-Paint 26 | **Slow-Drying Linseed Oil Black Maintenance Primer (Without Lead or Chromate Pigment)** |
| SSPC-Paint 27 | **Basic Zinc Chromate—Vinyl Butyral Wash Primer** |
| SSPC-Paint 28 | **Water-Borne Epoxy Primer for Steel Surfaces** |
| SSPC-Paint 29 | **Zinc Dust Sacrificial Primer, Performance-Based** |
| SSPC-Paint 30 | **Weld-Through Inorganic Zinc Primer** |
| SSPC-Paint 31 | **Single-Package Water-Borne Alkyd Primer, Performance-Based** |
| SSPC-Paint 32 | **Coal Tar Emulsion Coating** |
| SSPC-Paint 33 | **Coal Tar Mastic, Cold Applied** |
| SSPC-Paint 34 | **Water-Borne Epoxy Topcoat for Steel Surfaces** |
| SSPC-Paint 35 | **Medium Oil Alkyd Primer (Air Dry/Low Bake)** |
| SSPC-Paint 36 | **Two-Component Weatherable Aliphatic Polyurethane Topcoat, Performance-Based** |
| SSPC-Paint 101 | **Aluminum Alkyd Paint** |
| SSPC-Paint 102 | **Black Alkyd Paint** |
| SSPC-Paint 103 | **Black Phenolic Paint** |
| SSPC-Paint 104 | **White or Tinted Alkyd Paint** |
| SSPC-Paint 106 | **Black Vinyl Paint** |
| SSPC-Paint 108 | **High-Build Thixotropic Leafing Aluminum Paint** |

## CHAPTER 7—PAINT APPLICATION STANDARDS, GUIDES, AND SPECIFICATIONS

| | |
|---|---|
| SSPC-PA COM | **Commentary on Paint Application** |
| SSPC-PA 1 | **Shop, Field, and Maintenance Painting of Steel** |
| SSPC-PA 2 | **Measurement of Dry Coating Thickness with Magnetic Gages** |
| SSPC-PA Guide 3 | **A Guide to Safety in Paint Application** |
| SSPC-PA Guide 4 | **Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems** |
| SSPC-PA Guide 5 | **Guide to Maintenance Painting Programs** |

## CHAPTER 8—QUALIFICATION PROCEDURES

| | |
|---|---|
| SSPC-QP COM | **Commentary on Qualification Procedures** |
| SSPC-QP 1 | **Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)** |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| SSPC-QP 2 | **Standard Procedure for Evaluating the Qualifications of Painting Contractors to Remove Hazardous Paint** |
| SSPC-QP 3 | **Standard Procedure for Evaluating the Qualifications of Shop Painting Contractors** |
| SSPC-QP 4 | **Standard Procedure for Evaluating the Qualifications of Contractors Disturbing Hazardous Paint During Demolition and Repair Work** |
| SSPC-QP 5 | **Standard Procedure for Evaluating the Qualifications of Coating and Lining Inspection Companies** |

CHAPTER 9—TECHNOLOGY GUIDES

| | |
|---|---|
| SSPC-Guide 6 | **Guide for Containing Debris Generated During Paint Removal Operations** |
| SSPC-Guide 7 | **Guide for the Disposal of Lead-Contaminated Surface Preparation Debris** |
| SSPC-Guide 9 | **Guide for Atmospheric Testing of Coatings in the Field** |
| SSPC-Guide 10 | **Guide to Specifying and Testing Coatings for Conformance with VOC Content Requirements** |
| SSPC-Guide 11 | **Guide for Coating Concrete** |
| SSPC-Guide 12 | **Guide for the Illumination of Industrial Painting Products** |
| SSPC-Guide 13 | **Guide for the Identification and Use of Industrial Coating Material in Computerized Product Databases** |
| SSPC-Guide 14 | **Guide for Repair of Imperfections in Galvanized or Inorganic Zinc-Coated Steel Using Organic Zinc-Rich Coating** |

CHAPTER 10—TECHNOLOGY UPDATES

| | |
|---|---|
| SSPC-TU 1 | **Surface-Tolerant Coatings for Steel** |
| SSPC-TU 2 | **Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment** |
| SSPC-TU 3 | **Overcoating** |
| SSPC-TU 4 | **Field Methods for Retrieval and Analysis of Soluble Salts on Substrates** |
| SSPC-TU 5 | **Accelerated Testing of Industrial Protective Coatings** |
| SSPC-TU 6 | **Chemical Stripping of Organic Coatings from Steel Surfaces** |
| SSPC-TU 7 | **Conducting Ambient Air, Soil, and Water Sampling During Surface Preparation and Paint Disturbance Activities** |

CHAPTER 11—TEST PANEL PREPARATION METHOD

| | |
|---|---|
| SSPC-ME 1 | **Uncontaminated Rusted Steel** |

**ADDRESSES OF REFERENCED ORGANIZATIONS**

**LIST OF STANDARDS AND SPECIFICATIONS REFERENCED IN VOLUME 2**


Provided by : www.spic.ir Licensee: NISOC Library

**The following specifications have been DISCONTINUED in the 1971 and later editions, but are available in single copies from SSPC.**

| | | Discontinued Date |
|---|---|---|
| SSPC-SP 4 | Flame Cleaning of New Steel | 1982 |
| SSPC-SP 9 | Weathering Followed by Blast Cleaning | 1971 |
| SSPC-Paint 1 | Red Lead & Raw Linseed Oil Primer | 1995 |
| SSPC-Paint 2 | Red Lead, Iron Oxide, Raw Linseed Oil & Alkyd Primer | 1995 |
| SSPC-Paint 3 | Red Lead, Iron Oxide & Fractionated Linseed Oil | 1971 |
| SSPC-Paint 4 | Extended Red Lead, Raw & Bodied Linseed Oil Primer | 1982 |
| SSPC-Paint 6 | Red Lead, Iron Oxide & Phenolic Varnish Paint | 1982 |
| SSPC-Paint 13 | Red or Brown One-Coat Shop Paint | 1995 |
| SSPC-Paint 14 | Red Lead, Iron Oxide & Linseed Primer | 1982 |
| SSPC-Paint 107 | Red Lead, Iron Oxide & Alkyd Intermediate Primer | 1995 |
| SSPC-PS 1.01 | Oil Base Paint System with Linseed Oil Primer & Alkyd Topcoat (for Weather-Exposed Wire-Brushed Steel) | 1982 |
| SSPC-PS 1.02 | Oil Base Paint System, Four-Coat, with Linseed Oil Primer (for Weather-Exposed Wire-Brushed Steel) | 1982 |
| SSPC-PS 1.03 | Oil Base Paint System with AASHTO Linseed Oil & Alkyd Paints (for Weather-Exposed Wire-Brushed Steel) | 1982 |
| SSPC-PS 1.04 | Three-Coat Oil-Alkyd (Lead- and Chromate-Free) Painting System for Galvanized or Non-Galvanized Steel (With Zinc Dust-Zinc Oxide Linseed Oil Primer) | 2000 |
| SSPC-PS 1.05 | Oil Base Paint System with Linseed Oil & Alkyd Primer (for Weather-Exposed Wire-Brushed Steel) | 1982 |
| SSPC-PS 1.06 | Oil Base Paint System with Red Lead Linseed Oil Primer | 1982 |
| SSPC-PS 1.07 | Three-Coat Oil Base Red Lead Painting System | 1995 |
| SSPC-PS 1.08 | Four-Coat Oil Base Red Lead Painting System | 1995 |
| SSPC-PS 1.11 | Three-Coat Oil Base Red Lead Painting System | 1995 |
| SSPC-PS 2.01 | Alkyd Paint System: Four-Coat System with Red Lead Primer (for Weather Exposure) | 1982 |
| SSPC-PS 2.02 | Alkyd Paint System: With Zinc Chromate Primer (for Weather Exposure) | 1982 |
| SSPC-PS 2.03 | Three-Coat Alkyd Painting System with Red Lead Iron Oxide Primer (for Weather Exposure) | 1995 |
| SSPC-PS 2.04 | Alkyd Paint System With Zinc Chromate Iron Oxide Primer (for Weather Exposure) | 1982 |
| SSPC-PS 2.05 | Three-Coat Alkyd for Unrusted Galvanized Steel (For Weather Exposure) | 2000 |
| SSPC-PS 4.01 | Four-Coat Vinyl Painting System with Red Lead Primer (For Salt Water or Chemical Use) | 1995 |
| SSPC-PS 4.03 | Three-Coat Vinyl Painting System with Wash Primer (For Salt Water and Weather Exposure) | 1995 |
| SSPC-PS 4.04 | Four-Coat White or Colored Vinyl Painting System (For Fresh Water, Chemical and Corrosive Atmospheres) | 1995 |
| SSPC-PS 4.05 | Three-Coat Vinyl Painting System with Wash Primer and Vinyl Alkyd Finish Coat (For Atmospheric Exposure) | 1995 |
| SSPC-PS 6.00 thru 6.03 | Now see SSPC-PS 19.00, PS 20.00, PS 21.00 and PS 22.00. | |
| SSPC-PS 7.01 | One-Coat Shop Paint System with Red or Brown Primer | 1982 |
| SSPC-PS 8.01 | One-Coat Rust Preventive Painting System with Thick-Film Compounds | 1995 |
| SSPC-PS 10.00 | Guide for Selecting Hot or Cold Applied Coal Tar Painting Systems | 1982 |
| SSPC-PT 1 | Wetting Oil Treatment | 1982 |
| SSPC-PT 2 | Cold Phosphate Surface Treatment | 1982 |
| SSPC-PT 3 | Basic Zinc Chromate-Vinyl Butyral Washcoat (Now see SSPC-Paint 27) | 1982 |
| SSPC-PT 4 | Hot Phosphate Surface Treatment | 1982 |

Provided by : www.spic.ir Licensee: NISOC Library

# HOW TO USE SSPC SPECIFICATIONS AND GUIDES

## 1. Scope of Volume 2

This volume covers the selection of painting systems for the protection of steel and concrete and is organized for use primarily in preparation of procurement documents for painting work. It can also be used educationally as illustrative of current good practice. It is the product of many years of broad open consensus work by the SSPC staff and by the leading specialists in each field of protective coatings technology. Most of the specifications presented here have been evaluated in actual use and in the principal SSPC exposure sites.

The aims of this eighth edition of Volume 2 are:

- To incorporate by means of composition/performance oriented specifications the best current technology on protective coatings;
- To update SSPC specifications based upon results of many years of experience with the existing ones;
- To present an association between "environmental zones" of exposure and the selection of painting system specifications;
- To implement the recommendations of Volume 1 of the SSPC Manual; and
- To facilitate the incorporation of SSPC specifications into procurement documents by reference.

## 2. Outline of Volume 2 Chapters

CHAPTER 1 describes how to use SSPC Specifications and Guides, with particular reference to the concept of selecting painting systems by "environmental zones."

CHAPTER 2 begins with a Commentary on Surface Preparation Specifications. This is followed by four visual standards for evaluating unpainted and previously painted steel surfaces along with the twelve SSPC surface preparation specifications.

CHAPTER 3 contains two SSPC/NACE joint technology reports, one on thermal precleaning and one on wet abrasive blast cleaning.

CHAPTER 4 contains the three SSPC abrasives specifications.

CHAPTER 5 begins with a Commentary on Painting System Specifications in general and the SSPC concept in particular. It is followed by all of the current SSPC painting system guides and specifications, each of which stipulates the required surface preparation, paint, paint thickness, and application. Two systems new to this edition are performance based materials specifications. These systems, an aluminum epoxy (PS-26.00) and an alkyd (PS 27.00), specify performance criteria to qualify only the coating material. Unlike the other painting systems, no surface preparation, thickness, or application methods are specified.

CHAPTER 6 begins with a Commentary on the use of SSPC Paint Specifications, including generic types and references to other specifications. This is followed by all of the current SSPC paint specifications.

CHAPTER 7 begins with a Commentary on Paint Application. Two of the documents in this chapter are specifications: paint application (PA 1) and dry film thickness measurement (PA 2). Three of the documents are guides: safety (PA Guide 3), maintenance repainting (PA Guide 4), and maintenance painting programs (PA Guide 5).

CHAPTER 8 presents four procedures for qualifying painting contractors (field and shop) and one procedure for qualifying inspection companies.

CHAPTER 9 consists of eight Technology Guides on a variety of topics.

CHAPTER 10 consists of eight Technology Updates on a variety of topics.

CHAPTER 11 contains a single specification on the preparation of uncontaminated rusted steel test panels.

The appendices have addresses and other information about all organizations referenced in this volume as well as a list of all standards referenced in this volume.

## 3. Definitions

The functional parts of this volume use terms such as specification, commentary, guide, or notes as indicated below:

- **Standard:** A specification, practice, or test method that has been formally adopted. SSPC standards include specifications and guides, each of which may refer to other standards.
- **Specification:** A form of standard that is a precise statement of a set of requirements to be satisfied by a material, product, system, or service.
- **Method:** A form of standard describing a precise procedure or technique used for performing a specific task.
- **Painting System:** A term intended to include, with equal emphasis, not only the well accepted components of a system such as surface preparation and paint materials, but also the application, inspection, and safety functions.
- **Painting System Materials Specification:** A specification that covers only the paint in a multicoat system without specifying surface preparation, film thickness, and application.

Provided by : www.spic.ir Licensee: NISOC Library

- **Coating System:** A term which refers to the applied and cured multi-layer film or to the components of a system based on non-paint type coating such as thermal spray coatings.
- **Commentary:** Explanatory remarks at the beginning of a chapter, describing the background and proper use of the specifications and guides. (This is not a part of the specifications and guides, but often is important in their selection and use.)
- **Guide:** A set of directions provided to aid in preparing one's own modified specifications. Painting System Guides are coded SSPC-PS Guide 1.00, 2.00, 3.00, 4.00, etc. and are to be used for cases not covered by the standard painting systems. Guides to safety (SSPC-PA Guide 3) and Maintenance (SSPC-PA Guides 4 and 5) aid in establishing standard practices, procedures, and specifications.
- **Notes:** Explanatory section at the end of a specification that provides additional information. Notes are not mandatory requirements unless otherwise specified.
- **Qualification Procedure:** Defined sequence of actions or functions to establish or verify a specified level of quality or competence.
- **Joint Technology Report:** Issued by an SSPC/NACE technical committee to address the state of the art of a particular technology.
- **Technology Update:** A consensus SSPC document prepared by a committee that describes and assesses a new material, procedure, concept, method, or other area of technology. Technology Updates are considered “fast track” documents and skip some steps in the standards approval process. A Technology Update differs from other types of SSPC standards in that it is not suitable for referencing in a specification or procurement document. It differs from a technical article in a journal in that it represents a consensus of balanced interests, not a single author’s viewpoint.

Other terms sometimes used in the industry include: practice—A form of standard that is a procedure, guide, or service that may or may not be auxiliary to a test method or a specification; test method—A form of standard that covers sampling and subsequent testing procedures used in determining the properties, composition, or performance for materials, products, systems, or services that may be specified. A test method does not include the kind of numerical limits for the properties, composition, or performance that should normally be included in a specification. Other terms are covered in the Glossary section of Volume 1 of the Steel Structures Painting Manual and in the Protective Coatings Glossary (SSPC 00-07).

## 4. Identification Numbers Used for SSPC Specifications and Guides

Abbreviations are used extensively in the designations of SSPC specifications. SSPC refers to “Steel Structures Painting Council” which was the name of the organization prior to 1997. The complete designation requires a specification number, the year of issue, and if the specification is tentative, a suffix letter "T”. For example, SSPC-Paint 8-55T refers to Paint No. 8, which was issued as tentative in 1955. When adopted in 1964, the "T" was dropped and the year of revision was substituted, resulting in a designation: SSPC-Paint 8-64. After review and revision in 1982 it is designated SSPC-Paint 8-82.

More recently, the letter “I” after the number indicates interim status. This designation is given to a “fast track” document which results when several steps in the approval process are skipped in order to meet the demand for rapid issuance of information. The Standards Review Committee can grant interim status by extending the expiration date of a published consensus document when it is still undergoing the mandatory review and revision process. For example, CS 23.00(I) is a joint standard that has been approved by SSPC but not by the other organizations.

Designations for the SSPC standards, specifications, technology reports, technology updates, and their abbreviations are listed below. The term "Paint," used as the designation for SSPC Paint Specifications, is the only term not abbreviated.

| | | |
|---|---|---|
| PS | = | Painting System |
| CS | = | Coating System |
| Paint | = | Paint (or Coating) |
| SP | = | Surface Preparation |
| AB | = | Abrasive |
| PA | = | Paint Application |
| QP | = | Qualification Procedure |
| ME | = | Method (of preparing test panels) |
| TR | = | Technology Report |
| TU | = | Technology Update |

The word "Guide" is placed before the number portion of the identification for those documents that are Guides; for example, PA-Guide 3.

The latest issue of the specification is to be used unless otherwise specified. If for any reason the specifier should want to employ an earlier version, he may do so merely by specifying, for example, that SSPC-SP 10-63T, not SSPC-SP 10-00, is to be used. Such a stipulation would be very unusual, but the obsolete specifications can still be obtained from the SSPC.

## 5. Methods of Using SSPC Painting System Specifications

A reference statement that can make any SSPC Painting System Specification (or other SSPC Specification) a

Provided by : www.spic.ir Licensee: NISOC Library

formal part of any procurement document would be typified by the following: "The SSPC Painting System Specification (number and title) as published by SSPC: The Society for Protective Coatings, 40 24th St., 6th Floor, Pittsburgh, PA 15222." Prior to preparation of procurement documents, the preparer shall review the Commentary as well as the applicable specifications to be referenced in the procurement documents.

**Using Specifications Without Modifications or Amendments.** Each Painting System Specification may be used essentially in its entirety, by proper reference in the procurement documents, to cover all usual requirements for the intended use. To do so, simply specify that the steel or structure shall be painted in accordance with SSPC-PS __. Used without modification, these SSPC Painting Systems cover most of the normal painting problems that are encountered. Since each painting system describes the minimum requirement for the intended service, it follows that better methods or materials may be substituted without prejudice, provided the practical value of the improvement is judged to be commensurate with the added cost.

**Modifications of Specifications.** Modifications to reflect the needs of an individual project may be made by the preparer by reviewing each item of the applicable specification and then including his decisions on variations as mandatory requirements in the procurement documents. To do so, modify a standard specification by adding, deleting, or changing requirements.

**Use of Painting System Guides.** The preparer may use the Painting System Guides SSPC-PS Guide 1.00, 2.00, 3.00, etc. to prepare his/her own modified painting systems for special cases not covered by the standard systems. Recommendations for special conditions are shown in Table 1.

## 6. Selection of Painting Systems by Environmental Zone

**General Considerations.** Because of the wide diversity of available systems, the adverse conditions under which they must sometimes be applied, environmental restrictions, and the need for minimizing maintenance, the choice of a suitable painting system is not always an easy one. There is, of course, no one "best" painting system, but rather a dynamic competition among alternative materials and methods whose choice often depends both upon technological factors and policy considerations.

Since environmental factors are often the dominant ones, they will be considered here first, followed by other important considerations such as cost, appearance, and design.

**Effects of Environment on Corrosion Rates.** Among the technological factors in the choice of a painting system, environment is usually the controlling one. For example, one rule of thumb advocates that steel need not be painted at all when the corrosion rate is uniform and below a certain level; when the environment is too severe, on the other hand, alternative materials of construction should be considered instead of painting.

Table 2 illustrates the wide range of atmospheric corrosiveness as measured by the American Society for Testing and Materials varying a thousandfold in various part of the world. On the one hand, increased atmospheric contamination has resulted in acid rain waters, while on the other, many industrial locations are less contaminated than in the recent past.

**Environmental Zones:** A concise description of each SSPC “environmental zone” is given in Table 3, while Table 4 indicates typical painting system(s) recommended for minimum performance in each zone. These zones cover rural, urban, commercial, and marine environments and several special exposures. Use of the term "environmental zone" in this context is not meant to parallel the common meaning of the term, which implies geographical location but, rather, defines the type of environment (atmosphere) to which the coated steel will be exposed. As an example of this more specialized meaning of environmental zone, consider a steel framed building, part of which is devoted to office space, and another part of which is devoted to chemical laboratory and pilot plant space where acidic fumes are frequently generated. Each of these areas is exposed to a significantly different environment. Another example is the roadway and superstructure of a bridge located in a geographical area where freezing and road salt use are common. The upper portions of such a bridge have to be protected simply against weather exposure, whereas the roadway steel and adjacent structural components must be protected against de-icing salt in solution.

For purposes of classifying environmental exposures according to their severity, they have been divided into environmental zones from essentially non-corrosive dry interiors—Zone 0—to severe chemical exposures—Zone 3. Special conditions are listed in Table 1. Exposure conditions may be such as to require little or no protection by painting; conversely, they may indicate the need for elaborate surface preparation, pretreatment, and properly selected primer, intermediate, and finish coats. Although Table 4 may indicate several different generic painting systems suitable for use in a particular zone, some systems are more durable than others and will achieve better performance or longer coating life.

This classification of environment is probably the most useful type of designation, since most available data on paint exposures is defined in these broad terms. A more precise environmental classification in terms of time-of-wetness, chloride level, sulfur dioxide content, pH, conductivity, surface contamination, etc. is being investigated.

In Table 4, Painting System numbers have been rounded off to show the generic class of systems that are satisfactory. For example, SSPC-PS 15 includes Painting System Guide 15.00 and Painting System Specifications SSPC-PS 15.01 through 15.04.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**TYPICAL RECOMMENDATIONS FOR SPECIAL SERVICE CONDITIONS**

| Type of Service | Discussion and Recommendations |
|---|---|
| Abrasion Resistance | Urethane coatings probably have more abrasion resistance per mil than any other organic generic class. These are available as proprietary materials.<br><br>Epoxies such as modified SSPC-PS 13 can be specially formulated so that removal, even by blast cleaning, is difficult, especially when they are sand-filled.<br><br>Zinc-rich coatings, such as SSPC-PS 12, especially the inorganic types, tend to "polish" and not abrade off steel surfaces.<br><br>Coal tar epoxy paints, such as SSPC-PS 11, or selected proprietary products, especially when filled with garnet or other hard 30 to 70 mesh materials.<br><br>SSPC-PS 2, 3, 4, 10, 11, or 13 when sand-filled.<br><br>Gravel, sand, slate granules in SSPC-PS 9 or 10. |
| Anti-Sweat | Preformed plastic and foam spray have superseded paints for most anti-sweat functions. |
| Anti-Fouling | These paints are covered in SSPC-PS 19 and in Volume 1 of the Steel Structures Painting Manual. |
| Protection from Graffiti | See SSPC-PS 17 and polyester urethane guides with recommended ratios of polyol, isocyanate, and NCO. |
| Skid Resistance | Any type of paint that is suitable for application on floors can be converted to a specifically skid resistant paint by incorporation of a finely divided material such as silica, aluminum oxide, or ground shells. |
| Mildew Resistance | 1. Wash with phosphate-free detergent.<br>2. Rinse with a solution of one part sodium hypochlorite (Hilex, Clorox, Purex, etc.) and three parts water. Allow some dwell time before a final rinse.<br>3. Use a paint suitable for specific surface and exposure. |
| Piping | Color codes for identifying piping are given in ANSI A13.1, "Identification of Piping." |
| Safety Colors | Standards for safety colors are given in ANSI Z53.1, "Color Coding." |
| Wet Surfaces | Some epoxies and urethanes have been successfully applied to wet surfaces. |
| Cold Surfaces | Some urethanes can be applied to cold surfaces. Cycloaliphatic amine-cured epoxies can be used. |
| Underwater | Epoxies have been developed for underwater application. (Some urethanes will cure underwater but cannot be applied underwater.) |
| Rebar Protection | Fusion bonded epoxies or hot dip galvanizing. |

Such guides as Table 4 are intended to aid the specifier in selecting a painting system (including surface preparation, coatings, and application) but are, of course, no substitute for the knowledge and judgment entailed in an intelligent choice.

**Influence of Geographical Locations on Environmental Zones:**

- **Inland, rural locations,** far from coastal salt water, are free from the corrosive influence of airborne salt. The presumption that the atmosphere in these areas, located far from centers of heavy industry, are therefore "virtually unpolluted," has been drastically reversed. It is now seen that even rural locations, hundreds of miles distant from industrial plants and electrical power generating stations, can sometimes be subjected to acid rain generated by sulfur dioxide emissions. Rain water with a pH as low as 3-4 has been observed not only in rural, but also in wilderness locations. Therefore, preparers of painting system specifications must now cultivate a realistic awareness of atmospheric conditions prevailing in rural locations that were traditionally considered benign with respect to corrosion of steel.
- **Heavy industrial environments,** such as those involving coke plants, are severe enough to be classified in the chemical category. These envi-

Provided by : www.spic.ir Licensee: NISOC Library

ronments are marked by reduced paint life and high corrosion rates.

- **Marine** atmosphere is typified by frequent and relatively high concentrations of salt mist, but it does not imply direct contact with salt spray or splashing waves; it contains a high concentration of chlorides in contrast to the high concentration of sulfur dioxide in the industrial atmosphere.

**TABLE 2**
**SOME MEASURED CORROSION RATES[a]**

| Site No. | Location | Type of Atmosphere | Relative Rating Steel | Zinc |
|---|---|---|---|---|
| 1 | Normal Wells, N.W.T. | Rural | 0.02 | 0.2 |
| 2 | Saskatoon, Sask. | Rural | 0.2 | 0.2 |
| 9 | State College, PA[b] | Rural | 1.0 | 1.0 |
| 17 | Pittsburgh, PA (roof) | Industrial | 1.8 | 1.5 |
| 18 | London (Battersea) | Industrial | 2.0 | 1.2 |
| 27 | Bayonne, NJ | Industrial | 3.4 | 3.1 |
| 28 | Kure Beach, NC (250 m) | Marine | 3.6 | 1.9 |
| 31 | London (Strafford) | Industrial | 6.5 | 4.8 |
| 33 | Point Reyes, CA | Marine | 9.5 | 1.0 |
| 37 | Kure Beach, NC (25 m) | Marine | 33.0 | 6.4 |

[a] Adapted from ASTM Materials Research and Standards, December, 1961, page 977.
[b] State College, PA was taken as unity. Fortuitously, a corrosive of 1.0 represented about 1 mil loss the first year.

- **Fresh and salt water immersion** have important differences because of osmotic and electrolytic effects.
- **Alternate immersion** refers to frequent, perhaps fairly long immersion in water alternated with exposure to the atmosphere above the water—for example, the boottopping area of a ship's hull, or steel in the tidal range.
- **Condensation and high humidity** exposure refers to almost continuous condensation; exposure to high humidity alone (with little or infrequent condensation) is not considered to be in this class of exposure.
- **Chemical environments** are those in which strong concentrations of highly corrosive gases, fumes, or chemicals—either in solution, or as concentrated liquids or solids—contact the surface. The severity of exposure may vary tremendously from mild concentration in a yard area to direct immersion in the chemical substance.
- **Underground** refers to buried surfaces in direct contact with the soil, which may be high in salinity or acidity.

It should be understood that surfaces presumed to be exposed to the weather are indeed open to the elements. Structures open to pollution, but sheltered from rain, are particularly vulnerable.

**Special Service Requirements.** Some painting systems for special services, including resistance to abrasion, fouling, graffiti, mildew, and skidding, are listed in Table 1.

**TABLE 3**
**SSPC ENVIRONMENTAL ZONES**

| | |
|---|---|
| 0 | Dry interiors where structural steel is imbedded in concrete, encased in masonry or protected by membrane or non-corrosive contact type fireproofing. |
| 1A | Interior, normally dry (or temporary protection). Very mild (oil base paints now last six years or more). |
| 1B | Exteriors, normally dry (includes most areas where oil base paints now last six years or more). |
| 2A | Frequently wet by fresh water. Involves condensation, splash, spray or frequent immersion. (Oil base paints now last five years or less.) |
| 2B | Frequently wet by salt water. Involves condensation, splash, spray or frequent immersion. (Oil base paints now last three years or less.) |
| 2C | Fresh water immersion |
| 2D | Salt water immersion |
| 3A | Chemical atmospheric exposure, acidic (pH 2.0 to 5.0) |
| 3B | Chemical atmospheric exposure, neutral (pH 5.0 to 10.0) |
| 3C | Chemical atmospheric exposure, alkaline (pH 10.0 to 12.0) |
| 3D | Chemical atmospheric exposure, presence of mild solvents. Intermittent contact with aliphatic hydrocarbons (mineral spirits, lower alcohols, glycols, etc.) |
| 3E | Chemical atmospheric exposure, severe. Includes oxidizing chemicals, strong solvents, extreme pH's or combinations of these with high temperatures. |

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 4**
**ENVIRONMENTAL ZONES FOR WHICH SSPC PAINTING SYSTEMS ARE RECOMMENDED**

| PAINTING SYSTEM | | ENVIRONMENTAL ZONE (from Table 3) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSPC # | GENERIC TYPE | 0 | 1A | 1B | 2A | 2B | 2C | 2D | 3A | 3B | 3C | 3D | 3E |
| PS 1 | Oil base | | X | X | | | | | | | | | |
| PS 2 | Alkyd | | X | X | | | | | | | | | |
| PS 3 | Phenolic (oleoresinous) | | X | X | X | | | | | | | | |
| PS 4 | Vinyl | | X | | X | X | X | X | X | X | | | |
| PS 7 | One-coat shop | X | X | | | | | | | | | | |
| PS 9 | Cold-applied asphalt mastic | | | | X | X | | | | X | X | | |
| PS 10 | Coal tar mastic or enamel | | | | | | X | | | X | X | | |
| PS 11 | Coal tar epoxy | | | | X | X | X | X | X | X | X | | |
| PS 12 | Zinc-rich (untopcoated) | | X | X | X | X | X | X | | X | | X | |
| PS 12 | Zinc-rich (topcoated) | | X | X | X | X | X | X | X | X | X | X | |
| PS 13 | Epoxy-polyamide (non-immersion)** | | | | X | X | | | | | | | |
| PS 14 | Steel joist shop paint | | X | | | | | | | | | | |
| PS 15 | Chlorinated rubber | | X | X | X | X | X | X | X | X | X | | |
| PS 16 | Silicone alkyd | | | | X | | | | | | | | |
| PS 17 | Urethane | | X | X | X | X | | | | X | X | | |
| PS 18 | Latex | | X | X | | | | | | | | | |
| PS 19 | Ship bottoms | | | | | | | X | | | | | |
| PS 20 | Ship boottoppings | | | | | X | | X | | | | | |
| PS 21 | Ship topsides | | X | X | X | X | | | | | | | |
| PS 22 | One-coat preconstruction | | X | X | | | | | | | | | |
| CS 23 | Thermal spray metallic | | X | X | X | T | X | T | T | T | T | | |
| PS 24 | Latex (performance based) | | X | X | X | X | | | X | X | X | X | |
| PS 26 | Aluminum epoxy (performance based) | | X | X | X* | X* | | | | | | | |
| PS 27 | Alkyd (performance based) | | X | X | X* | X* | | | | | | | |

NOTES:
Zones for use are those recommended by the committee that developed the specification.
PS 4 (vinyl) and PS 15 (chlorinated rubber) do not meet VOC restrictions and are rarely used.
** For immersion service, proprietary epoxy and urethane coatings are usually used.
T = Recommended only with proper sealing or topcoating
PS 26 and PS 27 are material specifications and cover only the paint.
X* = Excluding immersion
For Zone 3E use specific exposure data to select a coating.
Because more than one system is recommended for a particular zone does not mean that they will all perform equally well.

## 7. Other Factors in Painting System Selection

Although environment is usually the primary factor in the choice of a coating system, other factors such as costs, application, surface preparation, appearance, design, available facilities, and availability of specifications must also be considered.

**Costs** per unit area per year should really be minimized over the projected life of the structure. Sophisticated engineering calculations are sometimes justified, since the cost of coatings during the total life cycle of a structure often exceeds the initial cost of the structure itself. At times in the economic cycle these cost calculations are simplified when money interest rates are of the same order of magnitude as the inflation rate. During these periods a dollar set aside initially at current interest rates may be presumed to have the same purchasing power when it is ready to be spent at some future date.

In many cases it is more economical to use a "deluxe" painting system (for example, top-coated zinc-rich over near-white blast cleaned steel as per SSPC-PS 12.00) than a "low cost" system (such as SSPC-PS 1.09) in a situation

Provided by : www.spic.ir Licensee: NISOC Library

where the life of the latter is five years or less.

In many U.S. environments, however, a coating life of seven or more years can be obtained with a simple alkyd paint system. Here it becomes more difficult to justify on a purely economic basis the high initial cost entailed in a potentially more durable system. Such systems usually involve more expensive surface preparation and application and are less tolerant of lapses in workmanship. The cost of the paint itself is, of course, a relatively minor consideration since surface preparation and application costs are usually from two to ten times the material costs.

**Appearance** is a major consideration in painting many bridges, tanks, refineries, plants, etc., and color is often chosen to harmonize or contrast with adjacent topographic or community features. Appearance plays an increasingly important role in structural painting, but corrosion prevention is necessary to retain that appearance.

**Engineering Design** of a steel structure can often render protection by paint either relatively straightforward or almost impossible. Chapter 25 of Volume 1 of the SSPC Painting Manual discusses alternative coating practices which should influence the design of structures. These include designs that provide for adequate drainage to avoid entrapment of water; avoidance of crevices that prevent satisfactory application of paint both in original painting and in maintenance painting; and avoidance of sharp edges, either by original rolling to edges with a reasonable radius, or by the requirement of grinding off sharp outside corners.

**Facilities Available** or methods permissible sometimes limit the type of surface preparation, application, or coatings that can be specified. Sometimes where blast cleaning is impractical or prohibited, the use of high performance coatings that demand rigorous surface preparation must be bypassed in favor of oil base or alkyd paints, or high solids penetrating epoxies (epoxy mastics), or urethanes possessing lesser resistance properties but greater penetration and better tolerance for residues of rust, oil, and dirt.

**Sequence.** All elements of the system should be sequentially compatible: the surface preparation with the primer, the primer with the intermediate paint(s), and so on to the finish coat.

**Availability of Specifications** is essential for many types of public and private structures in the U.S., where policy encourages the procurement of materials and services on an open competitive basis. Performance criteria are used whenever possible, but in practice, composition requirements must also be included. Some users also prefer to specify by proprietary product name based upon proven past performance or by qualified products lists.

**Environmental Constraints** are causing the industry to look carefully at alternatives to sand blasting, at new inhibitive types of pigment, and at new coatings with very low volatile organic compound (VOC) content. Much surface preparation work, for example, is concerned with removal of blast residue, with the substitution of low-free-silica abrasives for sand, with the use of metallic and other recyclable abrasives, with new wet blast techniques, and with entirely new surface preparation concepts.

**Shop Painting Versus Field Painting Versus Deferred Painting.** In new work it is common to carry out the surface preparation and priming in the shop, touch-up in the field, and finish coating after erection. Other practices are sometimes followed, such as deferring the second coat of paint for several years when the original primer was a zinc-rich. This practice may have tax advantages and has often proven technically feasible. However, postponing the second coat of an oleoresinous paint more than six months can be disastrous and is not recommended.

**Contract Painting Versus "In-House" Painting.** Many large users have their own highly qualified full-time crews whereas others favor the use of a knowledgeable contractor whose sole business is painting. The painting contract usually provides for either a "cost plus" basis (at a competitive overhead rate) or a "hard dollar" basis, usually based upon competitive bidding.

**Annual Fee Painting** is a type of painting contract in which the contractor agrees, for a specified annual fee, to do whatever painting is necessary to maintain a given plant at a specified high level of protection (e.g., SSPC-VIS 2, Rust Grade 8 or better). This arrangement provides an incentive to minimize cost without sacrificing quality.

## 8. Additional References

Volume 1 of the SSPC Painting Manual offers background on the selection of painting systems in a wide range of industries and environments: steel, petroleum, water, food, paper, power, chemical, highway, railway, salt water, fresh water, tank building, hydraulics, underground, sewage, and government installations. It also presents a background on corrosion, all types of surface preparation, coatings materials, application, inspection, costs, design, failure prevention, and sources of other information.

SSPC's Journal of Protective Coatings and Linings is a monthly publication which covers all aspects of protective coatings technology for a wide variety of industries.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# SURFACE PREPARATION SPECIFICATIONS

## Surface Preparation Commentary for Steel and Concrete Substrates

### 1. Introduction

This Surface Preparation Commentary (SP COM) is intended to be an aid in selecting the proper surface preparation method, materials, and specification for steel, concrete, and other metallic substrates. A compilation of standards, guides, and specifications related to the surface preparation and coating of concrete is available as a separate publication from SSPC. The SP COM is not part of the actual specification, but is included 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, represent a broad consensus of users, suppliers, and public interest groups. Details of the methods used to measure many of the properties in this SP COM are described in SSPC publication 97-07, The Inspection of Coatings and Linings, A Handbook of Basic Practice for Inspectors, Owners, and Specifiers.

### 2. Contents

1. Introduction
2. Contents
3. Importance of Surface Preparation
4. Surface Conditions
   - 4.1 New Construction
   - 4.2 Maintenance
   - 4.3 Surface Contaminants
     - 4.3.1 Rust
     - 4.3.2 Mill Scale
     - 4.3.3 Grease and Oil
     - 4.3.4 Dirt and Dust
     - 4.3.5 Moisture
     - 4.3.6 Soluble Salts
     - 4.3.7 Paint Chalk
     - 4.3.8 Deteriorated Paint
   - 4.4 Surface Defects
     - 4.4.1 Welds and Weld Spatter
     - 4.4.2 Weld Porosity
     - 4.4.3 Sharp Edges
     - 4.4.4 Pits
     - 4.4.5 Laminations, Slivers
     - 4.4.6 Crevices
   - 4.5 Rust Back
5. Summary of SSPC Surface Preparation Specifications
   - 5.1 SSPC-SP 1, "Solvent Cleaning"
     - 5.1.1 Petroleum and Coal Tar Solvents, and Turpentine
     - 5.1.2 Alkaline Cleaners
     - 5.1.3 Emulsion Cleaners
     - 5.1.4 Steam Cleaning
     - 5.1.5 Threshold Limit Values
     - 5.1.6 Paint Removal
   - 5.2 SSPC-SP 2, "Hand Tool Cleaning"
     - 5.2.1 Loose Rust, Mill Scale, and Paint
     - 5.2.2 Visual Standards
   - 5.3 SSPC-SP 3, "Power Tool Cleaning"
     - 5.3.1 Loose Rust, Mill Scale, and Paint
     - 5.3.2 Visual Standards
   - 5.4 SSPC-SP 4, "Flame Cleaning of New Steel"
   - 5.5 SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning"
     - 4.5.1 Visual Standards
   - 5.6 SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning"
     - 4.6.1 Visual Standards
   - 5.7 SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning"
     - 4.7.1 Visual Standards
   - 5.8 SSPC-SP 8, "Pickling"
   - 5.9 SSPC-SP 9, "Weathering Followed by Blast Cleaning"
   - 5.10 SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning"
     - 5.10.1 Visual Standards
   - 5.11 SSPC-SP 11, "Power Tool Cleaning to Bare Metal"
     - 5.11.1 Power Tools and Cleaning Media
     - 5.11.2 Power Tools with Vacuum Shrouds
     - 5.11.3 Visual Standards
   - 5.12 SSPC-SP 12/NACE No. 5, “Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating”
     - 5.12.1 Surface Cleanliness
     - 5.12.2 Flash Rusting
     - 5.12.3 Visual Standards
   - 5.13 SSPC-SP 13/NACE No. 6, “Surface Preparation of Concrete”
   - 5.14 SSPC-SP 14/NACE No. 8, “Industrial Blast Cleaning”
     - 5.14.1 Visual Standards
6. Selection of Abrasives, Blast Cleaning Parameters, and Equipment
   - 6.1 Abrasive Characteristics
     - 6.1.1 Hardness
     - 6.1.2 Size

Provided by : www.spic.ir Licensee: NISOC Library

6.1.3 Shape
6.1.4 Bulk Density
6.1.5 Friability/Waste Generation
6.1.6 Recyclability
6.2 Factors Affecting Surface Profile
6.3 Parameters That Affect Productivity
6.3.1 Particle Size
6.3.2 Hardness
6.3.3 Shape
6.3.4 Specific Gravity
6.3.5 Nozzle Pressure
6.3.6 Nozzle Type
6.3.7 Nozzle to Surface Distance
6.3.8 Impact Angle
6.3.9 Abrasive Metering
6.3.10 Abrasive Cleanliness
6.3.11 Embedment
6.4 Abrasive Types
6.4.1 Metallic Abrasives
6.4.2 Non-Metallic Abrasives
6.5 Blast Equipment
6.5.1 Conventional Blasting
6.5.2 Vacuum Blasting
6.5.3 Abrasive Blast Cleaning Above 760 kPa (110 psi)
7. Summary of SSPC Abrasive Specifications
7.1 SSPC-AB 1, "Mineral And Slag Abrasives"
7.2 SSPC-AB 2, “Specification for Cleanliness of Recycled Ferrous Metallic Abrasives”
7.3 SSPC-AB 3, “Newly Manufactured or Re-Manufactured Steel Abrasives”
8. Wet Abrasive Blast and Water Jetting Methods
8.1 Water Cleaning and Water Jetting without Abrasive
8.1.1 Degrees of Cleaning
8.1.2 Profile
8.1.3 Water Consumption
8.1.4 Equipment
8.1.5 Flash Rust
8.2 Wet Abrasive Blast Cleaning
8.2.1 Air/Water/Abrasive Blasting
8.2.2 Water/Abrasive Blast Cleaning
8.3 Flash Rust and Inhibitors
9. Other Cleaning Methods
9.1 Chemical Stripping
9.2 Sodium Bicarbonate Blasting
9.3 Sponge Jetting
9.4 Carbon Dioxide (Dry Ice) Blasting
9.5 Electrochemical Stripping
10. Film Thickness
11. Visual Standards
11.1 SSPC-VIS 1-89,"Visual Standard For Abrasive Blast Cleaned Steel"
11.2 SSPC-VIS 2, “Standard Method Of Evaluating Degree Of Rusting On Painted Steel Surfaces”
11.3 SSPC-VIS 3, "Visual Standard For Power- and Hand-Tool Cleaned Steel"
11.4 SSPC-VIS 4/NACE No. 7, “Interim Guide And Visual Reference Photographs For Steel Cleaned By Water Jetting”
11.5 ISO Visual Standards
11.6 Other Photographic Standards
11.7 Project Prepared Standards
12. Other SSPC Surface Preparation Documents in this Volume
12.1 SSPC-TR 1/NACE 6G194, “Joint Technology Report on Thermal Precleaning”
12.2 SSPC-TR 2/NACE 6G198, “Joint Technical Report on Wet Abrasive Blast Cleaning”
12.3 SSPC-TU 2/NACE 6G197, “Informational Report and Technology Update on Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment”
12.4 SSPC-TU 4, “Field Methods for Retrieval and Analysis of Soluble Salts on Substrates”
12.5 SSPC-TU 6, "Chemical Stripping of Organic Coatings from Steel Structures"
13. Non-SSPC Cleaning Specifications
14. Surface Preparation of Concrete for Coating
14.1 Industry Standards
14.2 Methods of Cleaning Concrete

## 3. Importance of Surface Preparation

Often, the surface preparation of steel for painting requires a three step process: 1) initial pre-cleaning to remove grease, oil, and dirt; 2) cleaning with hand/power tools, pressurized water, chemicals, or abrasive blasting; 3) creation or verification of the proper anchor pattern profile. The life of a coating depends as much on the degree of surface preparation as on the selected coating system, because most coating failures can be attributed to inadequate surface preparation or lack of coating adhesion. Surface preparation, therefore, should receive thorough consideration. The primary functions of surface preparation are:

- To remove surface contaminants that can induce premature coating failure.
- To provide a clean surface with adequate profile for good coating adhesion.

Where abrasive blast cleaning is not allowed or is impractical, alternative abrasives or methods of cleaning the surface must be employed. Chemical stripping will remove paint and is relatively easy to contain. Hence, chemical stripping may be used around sensitive machinery or in densely populated areas. (Refer to SSPC-TU 6, “Chemical Stripping of Organic Coatings from Steel Structures.”) Alternative abrasives such as sodium bicarbonate (baking soda) or dry ice ($CO_2$) can sometimes be used in places where conventional abrasives cannot be used. A class of abrasives has been developed where each abrasive particle is contained in a urethane sponge. The sponge

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**SUMMARY OF CURRENT SSPC ABRASIVE AND SURFACE PREPARATION SPECIFICATIONS**

| SSPC SPECIFICATION | DESCRIPTION |
|---|---|
| AB 1<br>Mineral and Slag Abrasives | Definition of requirements for selecting and evaluating mineral and slag abrasive used for blast cleaning. |
| AB 2<br>Specification for Cleanliness of Recycled Ferrous Metallic Abrasive | Cleanliness requirements for a recycled work mix and a description of the test procedures. |
| AB 3<br>Newly Manufactured or Re-Manufactured Steel Abrasives | Requirements of chemical and physical properties of steel abrasives. |
| SP 1<br>Solvent Cleaning | Removal of oil, grease, dirt, soil, salts, and contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam. |
| SP 2<br>Hand Tool Cleaning | Removal of loose rust, loose mill scale, and loose paint to degree specified, by hand chipping, scraping, sanding, and wire brushing. |
| SP 3<br>Power Tool Cleaning | 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/NACE No. 1<br>White Metal Blast Cleaning | 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 warranted. |
| SP 6/NACE No. 3<br>Commercial Blast Cleaning | Blast cleaning until at least two-thirds of the surface is free of all visible residues with only staining permitted on the remainder. For conditions where a thoroughly cleaned surface is required. |
| SP 7/NACE No. 4<br>Brush-Off Blast Cleaning | Blast cleaning of all except tightly adhering residues of mill scale, rust, and coatings, while uniformly roughening the surface. |
| SP 8<br>Pickling | Complete removal of rust and mill scale by acid pickling, duplex pickling, or electrolytic pickling. |
| SP 10/NACE No. 2<br>Near-White Blast Cleaning | Blast cleaning nearly to White Metal cleanliness, until at least 95% of the surface is free of all visible residues with only staining permitted on the remainder. For high humidity, chemical atmosphere, marine, or other corrosive environments. |
| SP 11<br>Power Tool Cleaning to Bare Metal | Complete removal of all rust, scale, and paint by power tools, with resultant surface profile. |
| SP 12/NACE No. 5<br>Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating | Defines four degrees of cleaning for visible contaminants (similar to SP 5, 6, 7, and 10) and three levels of surface cleanliness for non-visible soluble salt contamination. |
| SP 13/NACE No. 6<br>Surface Preparation of Concrete | Description of inspection procedures prior to surface preparation, methods of surface preparation, inspection, and classification of prepared concrete surfaces. |
| SP 14/NACE No. 8<br>Industrial Blast Cleaning | Between SP 7 (brush-off) and SP 6 (commercial). The intent is to remove as much coating as possible, but contaminants difficult to remove can remain on 10 percent of the surface. |
| VIS 1-89<br>Visual Standard for Abrasive Blast Cleaned Steel | Standard reference photographs; recommended supplement to SSPC Surface Preparation Specifications SSPC-SP 5, 6, 7, and 10. |
| VIS 2<br>Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces | A geometric numerical scale for evaluating degree of rusting of painted steel. Color photographs show staining while matching black and white images depict only rust. Three rust distributions, general, spot, and pinpoint, are depicted. |
| VIS 3<br>Visual Standard for Power- and Hand-Tool Cleaned Steel | Standard reference photographs; recommended supplement to SSPC-SP 2, 3, and 11. |
| VIS 4/NACE No. 7<br>Interim Guide and Visual Reference Photographs for Steel Cleaned by Water Jetting | Standard reference photographs depict previously rusted steel cleaned by water jetting. Photographs depict three levels of flash rusting. Recommended as a supplement to SSPC-SP 12. |

Provided by : www.spic.ir Licensee: NISOC Library

contains the abrasive and facilitates cleanup and recycling.

An advantage of all wet blast methods is the control of dust emissions. Wet blast methods may involve water alone, abrasive injected into the water stream, water injected into an abrasive air stream, or a water curtain surrounding an air/abrasive stream. Power tools with vacuum shrouds have also been proven effective in controlling dust emissions, particularly in removing lead containing paint. In applications where the presence of soluble salts on the steel surface creates a serious problem, such as tank linings, it may be beneficial to incorporate water into the cleaning process.

To gain maximum benefit from a high performance industrial coating, it is not prudent to cut back on the surface preparation. Surface preparation is important even when a "surface tolerant" coating is used. When the manufacturer claims a particular coating will "tolerate" a given amount of rust, old paint, or other contamination on the steel surface, it is likely that the coating will perform even better if the surface is prepared to a higher level of cleanliness.

## 4. Surface Conditions

The initial condition of the surface to be cleaned will determine the amount of work, time, and money required to achieve any particular degree of surface cleanliness. It is more difficult to remove contaminants from rusty steel than from intact mill scale. Therefore, it is necessary to consider the surface condition prior to selecting the method of cleaning.

The initial condition of the steel may determine the choice of abrasive to be used. Steel shot is an economical and effective choice for removing intact mill scale. However, if the steel is rusted and/or pitted, a more angular abrasive such as steel grit or a nonmetallic mineral abrasive will more effectively "scour out" the rust.

Although there are almost an infinite number of initial conditions, they can be broadly categorized as follows:

- New construction—steel not previously painted
- Maintenance—previously painted steel
- Surface contaminants—common to both new construction and maintenance

**4.1 NEW CONSTRUCTION:** For new construction there are four surface conditions based upon the rust grade classifications of SSPC-VIS 1-89, "Visual Standard for Abrasive Blast Cleaned Steel" as follows:

Rust Grade A - Steel surface covered completely with adherent mill scale; little or no rust visible
Rust Grade B - Steel surface covered with both mill scale and rust
Rust Grade C -Steel surface completely covered with rust; little or no pitting visible
Rust Grade D -Steel surface completely covered with rust; pitting visible

**4.2 MAINTENANCE:** The pictorial standard SSPC-VIS 3, "Visual Standard for Power- and Hand-Tool Cleaned Steel," defines conditions E, F and G for previously painted surfaces.

Condition E - Light-colored paint applied over a blast-cleaned surface, paint mostly intact.
Condition F - Zinc-rich paint applied over blast-cleaned steel, paint mostly intact.
Condition G - Painting system applied over mill scale bearing steel; system thoroughly weathered, thoroughly blistered, or thoroughly stained.

In maintenance repainting, the degree of surface preparation required depends on the new painting system and on the extent of degradation of the surface to be painted. The amount of rusting on a surface is based on the numerical scale of 0 to 10 given in SSPC-VIS 2 (ASTM D 610), "Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces," where a rating of 10 indicates no rust and a rating of 0 indicates totally rusted. SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," suggests the minimum surface preparation needed for each degree of rusting. The SSPC Painting System Commentary will also help in estimating surface preparation requirements.

In estimating rust percentages, photographs and schematic diagrams of the type shown in SSPC-VIS 2 can serve as practical aids. The Guide to SSPC-VIS 2, published in this volume, shows black and white schematics of actual rust patterns which serve as guides for judging the percentage of surface covered by rust (after removal of stains) or rust blisters. The present edition of SSPC-VIS 2 shows three different configurations of rusting – general, pinpoint, and spot rust, rather than the single configuration that was available prior to 2000.

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.

**4.3 SURFACE CONTAMINANTS:** Typical contaminants that should be removed during surface preparation are rust, corrosion products, mill scale, grease, oil, dirt, dust, moisture, chloride salts, sulfate salts, paint chalk, and loose, cracked, or peeling paint.

**4.3.1 Rust:** Rust consists primarily of iron oxides, the corrosion products of steel. Whether loose or relatively tightly adherent, rust must be removed for satisfactory coating performance. Rust resulting from the corrosion of

Provided by : www.spic.ir Licensee: NISOC Library

steel is not a good base for applying coatings because it expands and becomes porous. So-called "over-rust primers" (also referred to as "rust converters") do not perform as well as conventional coatings applied over clean steel, and the effectiveness of rust converters is unproven.

**4.3.2 Mill Scale:** Mill scale is a bluish, somewhat shiny oxide residue that forms on steel surfaces during hot rolling. Although initially tightly adhering, it eventually cracks, pops, and disbonds. As a general rule, unless completely removed before painting, it will later cause the coatings to crack and expose the underlying steel. Steel is anodic to mill scale and so corrodes more rapidly in this combination of "dissimilar metals."

Mill scale is erratic in its effect upon the performance of coatings. Tightly adhered or intact mill scale may not have to be removed for mild atmospheric exposure. If, however, the steel surface is to be coated with primers with low wetting properties or exposed to severe environments such as chemical exposures or immersion in fresh or salt water, then removal of mill scale by blast cleaning to a minimum SSPC-SP 6, "Commercial Blast Cleaning," is necessary.

**4.3.3 Grease and Oil:** Even thin films of grease and oil, which may not be readily visible, can prevent tight bonding of coatings. Visible deposits of grease and oil should be removed by solvent cleaning, SSPC-SP 1, prior to abrasive blast cleaning. If this precleaning is not done, the abrasive blasting may spread the grease or oil over the surface without removing it.

**4.3.4 Dirt and Dust:** Dirt and dust can also prevent tight bonding of coatings, and should be removed completely.

**4.3.5 Moisture:** Steel surfaces must be dry before blast cleaning and painting. Moisture may either produce flash rusting before painting or accelerate underfilm corrosion after painting. Water can also prevent an organic coating from properly "wetting out" the surface on metal or concrete surfaces, and may disrupt the curing of the coating.

**4.3.6 Soluble Salts:** Soluble salts are deposited from the atmosphere onto surfaces. If they remain on the surface after cleaning, they can attract moisture which can permeate the coating and cause a blister (osmotic blistering). Salts, particularly chlorides, may also accelerate the corrosion reaction and underfilm corrosion. Methods for measuring the amount of salt on the surface are described in SSPC-TU 4, "Field Methods for Retrieval and Analysis of Soluble Salts on Substrates." In some circumstances it is desirable to remove soluble salts by power washing or other method prior to abrasive blast cleaning.

**4.3.7 Paint Chalk:** The sun's ultraviolet light causes all exterior organic coatings to chalk to some extent. Chalk is the residue left after deterioration of the coating's surface organic binder. All loose chalk must be removed before coating in order to avoid intercoat adhesion problems. It is often specified that, before topcoating, old paint must have a rating of no less than 8 in accordance with ASTM D 4214, "Test Method for Evaluating Degree of Chalking of Exterior Paint Films."

**4.3.8 Deteriorated Paint:** All loose paint must be removed before maintenance painting. Before removing any old paint, it must be determined whether the paint contains significant amounts of lead or other toxic material. If so, then special precautions must be taken to protect workers, others in the area, and the environment.

**4.4 SURFACE DEFECTS:** Coatings tend to draw thin and pull away from sharp edges and projections, leaving little or no coating to protect the underlying steel, thereby increasing the potential for coating failure. Other features which are difficult to properly cover and protect include crevices, weld porosity and laminations discussed below. The high cost to remedy these surface imperfections requires weighing the benefits of edge rounding or grinding, versus a potential coating failure.

Poorly adhering contaminants, such as weld slag residues, loose weld spatter, and some minor surface laminations, may be removed by abrasive blast cleaning. Other surface defects, such as steel laminations, weld porosities, or deep corrosion pits, may not be evident until after abrasive blast cleaning. Therefore, the timing of such surface repair work may occur before, during, or after preliminary surface preparation operations have begun.

**4.4.1 Welds and 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. Weld spatter that is not removed will have a low film thickness (as on sharp edges) and can disbond from the base metal, resulting in adhesion failure. Welds can also have sharp projections that may stick out of the wet paint. The details on grinding welds are discussed in NACE RP0178, "Standard Recommended Practice, Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to Be Lined for Immersion Service."

**4.4.2 Weld Porosity:** Areas of unacceptable porosity as defined in the American Welding Society standard AWS D1.1 should be investigated and, if needed, filled with acceptable filler material or closed over with a needle gun or peening hammer prior to painting. Acceptable weld profiles, arc strikes, and weld cleaning are also addressed in Section 3 of AWS D1.1, "Structural Welding Code."

Provided by : www.spic.ir Licensee: NISOC Library

**4.4.3 Sharp Edges:** Sharp edges, such as those normally occurring on rolled structural members or plates, as well as those resulting from flame cutting, welding, grinding, etc., and especially shearing, could have an influence on coating performance and may need to be removed (e.g., grinding, mechanical sanding, filing). Care should be taken to ensure that during the removal operations, new sharp edges are not created.

**4.4.4 Pits:** Deep corrosion pits, gouges, clamp marks, or other surface discontinuities may require grinding prior to painting. The surface may also require filling with weld material.

**4.4.5 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. Filing may also be necessary.

**4.4.6 Crevices:** Areas of poor design for corrosion protection, such as tack or spot welded connections, back-to-back angles, crevices, etc., may require special attention. Where possible, such deficiencies should be corrected by structural or design modification. Where this is not possible, filling, and/or special surface preparation and painting procedures may be needed.

**4.5 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 contractor's 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.

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. If visible rust occurs prior to painting, surfaces must be re-cleaned to meet contract cleaning requirements (e.g. SSPC-SP 10/NACE No. 2). If immediate repainting is desired by the contractor but the job has no requirements for independent inspection to accept the quality of the cleaned surface, it is incumbent upon the contractor to verify, using recognized quality control tests, and document the quality of the cleaned surface before proceeding with application of the primer.

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 3 °C (5 °F) 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. If rust back is due to chemical contamination of the surface, the contaminant should be removed prior to coating, rather than coating the surface before rust back occurs.

## 5. Summary of SSPC Surface Preparation Specifications

Although these specifications are primarily intended for heavy metal or plate, most are also suitable for light weight or thin section metal. Obviously, caution must be exercised when using methods such as abrasive blast cleaning on thin gage metal since damage by warping 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 contract documents may need to modify the surface preparation specifications 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 SSPC Painting Manual devotes several chapters to mechanical surface preparation, and it also discusses special surface preparation requirements for shops, maintenance, railroads, highways, tanks, vessels, refineries, and various types of plants. This volume should be consulted when choosing a surface preparation specification.

The "Commentary on Paint Specifications" shows the minimum surface preparation required for each of the SSPC specification paints. Similarly, the "Commentary on Painting Systems" shows the recommended minimum surface preparation for each paint system and for the various individual alternative primers within each system, in ten common types of exposure.

The SSPC surface preparation specifications were numbered according to the chronological order in which they were adopted, not according to their degree of thor-

Provided by : www.spic.ir Licensee: NISOC Library

oughness of cleaning. For example, some time after SSPC-SP 5 (white metal) and SSPC-SP 6 (commercial) were issued, a need arose for a standard between these two. Hence, the standard for Near-White Blast Cleaning was developed, but the next available number was SSPC-SP 10. Similarly, SSPC-SP 14, "Industrial Blast Cleaning," is a degree of cleaning between SSPC-SP 7 (brush-off) and SSPC-SP 6 (commercial).

**5.1 SSPC-SP 1, "SOLVENT CLEANING":** This solvent cleaning specification includes simple organic solvent wiping, immersion in solvent, solvent spray, vapor degreasing, alkaline cleaning, emulsion cleaning, and steam cleaning.

Solvent cleaning is used primarily to remove oil, grease, dirt, soil, drawing compounds, and other similar organic compounds. Inorganic compounds such as chlorides, sulfates, weld flux, rust, and mill scale are not removed by cleaning with organic solvents.

Many solvents are hazardous. Care must be taken when using solvents for solvent cleaning. Special safety precautions must be followed with regard to ventilation, smoking, static electricity, respirators, eye protection, and skin contact.

Detergent/water cleaning is a very gentle method of solvent cleaning. Aqueous solutions of household detergents may be effective in the removal of light deposits of grease and oil. They seldom have adverse effects on substrates.

Alkaline cleaning compounds cover a wide range in composition and method of use. It is important that residues of alkaline compounds do not remain on the surface after cleaning. The cleaned surface may be tested with litmus paper or universal indicating paper to see that it is neutral or at least no more alkaline than the rinse water that is used. Various solvent, alkaline, and detergent cleaning compounds are discussed in Volume 1 of the SSPC Painting Manual.

**5.1.1 Petroleum and Coal Tar Solvents, and Turpentine:** These types of solvents clean the metal by dissolving and diluting the oil and greases which contaminate the surface. All solvents are potentially hazardous and they should be used under such conditions that their concentration in air being breathed by workmen is low enough for safety (see Table 2). When used in closed spaces where the safe concentration is exceeded, fresh air masks should be worn. The fresh air intake should be clear of carbon monoxide or other contaminants from engine exhausts or other sources. The concentration of solvent in air should not exceed the lower limit of flammability as fire or explosion may result. Some solvents, especially coal tar solvents (aromatics), will also dissolve the vehicle of paints so they can be removed. It is important that the last wash or rinse be made with clean solvent in every case or a film of oil or grease will be left on the surface when the solvent of the last washing evaporates. This film may interfere with the bond of the paint to the metal.

Petroleum base mineral spirits (aliphatics), with a minimum flash point of 38°C (100°F) should be used as the general purpose solvent for cleaning under normal conditions. In hot weather, or when the temperature is 25 to 35°C (80 to 95°F), high flash aliphatic mineral spirits with a minimum flash point of 50°C (122°F) should be used. In very hot weather, when the temperature is over 35°C (95°F), heavy mineral spirits with a flash point over 60°C (140°F) should be used. Gasoline and V.M. & P. Naphtha are too dangerous for use under ordinary conditions.

Aromatic or coal tar solvents may be used where greater solvency is required, but they are more toxic and the solvents generally available have low flash points. Benzol (benzene) is the most toxic and should not be used, particularly in view of its low flash point and attendant fire and explosion hazard. Xylol, toluol, and high flash naphtha may be used when their concentration in air that is being breathed does not exceed the safe limit (see Table 2). If the concentration is greater, fresh air masks should be worn. Because of the low flash points of these solvents, fire and explosion hazards are inherent with their use and great caution should be taken to ensure safe working conditions.

Chlorinated hydrocarbons may be used. However, due to toxicity, chlorinated hydrocarbons are not recommended for general use except with special equipment and trained operators. Chlorinated hydrocarbons should never be used where they may affect stainless steel.

"Safety solvents" are satisfactory for use provided that they meet the flash point requirements above and that they are used under such conditions that the concentration of chlorinated hydrocarbons in air does not constitute a health hazard (see Table 2).

**5.1.2 Alkaline Cleaners:** These cleaners saponify certain oils and greases, and their surface active constituents wash away other types of contaminants, such as oil. They may be particularly effective in removing paint because the alkali saponifies the dried paint vehicle. Since the soaps formed are soluble in water, the contaminants are more easily removed by washing with water after saponification. Although alkaline cleaners pose no problems to a steel substrate, they may cause significant damage to aluminum, zinc, wood, or concrete.

The most commonly used alkaline cleaner is trisodium phosphate, but there are other alkalies which are used. Some of these are mixtures with wetting agents and detergents. They are available as proprietary products and should be used in accordance with directions of the manufacturer.

Because of the paint removal action of many alkaline cleaners, the actual cleaner to be used should be chosen after consideration of the extent to which the paint may be damaged.

If no manufactured alkaline cleaner is available, good results may be achieved by the use of 15 grams of trisodium

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**THRESHOLD LIMIT VALUES (TLV) FOR SOLVENTS[4]**

| Substance | TLV-TWA[1] ppm | TLV-TWA[1] mg/m³ | TLV-STEL[2] ppm | TLV-STEL[2] mg/m³ |
|---|---|---|---|---|
| Acetone | 500 | 1780 | 750 | 2375 |
| Benzene (Benzol)—Skin | 0.5 | 30 | 2.5 | 75 |
| Butylcellosolve—Skin | 25 | 120 | 75 | 360 |
| Carbon Tetrachloride—Skin | 5 | 30 | 10 | 125 |
| Cyclohexane | 300 | 1050 | — | 1300 |
| Epichlorohydrin—Skin | 0.5 | 10 | — | 20 |
| Ethyl Acetate | 400 | 1400 | — | — |
| Ethanol (Ethyl Alcohol) | 1000 | 1900 | — | — |
| Ethylene Dichloride (1, 2-Dichloroethane) | 10 | 40 | — | 60 |
| Ethylenediamine | 10 | 25 | — | — |
| Furfuryl Alcohol—Skin | 10 | 40 | 15 | 60 |
| Methanol (Methyl Alcohol)—Skin | 200 | 260 | 250 | 310 |
| Methylene Chloride (Dichloromethane) | 50 | 350 | 100 | 1740 |
| Naphtha, Coal Tar[3] | — | — | — | — |
| Naphtha, Petroleum[3] | — | — | — | — |
| Perchloroethylene—Skin | 50 | 335 | 200 | 1340 |
| Isopropyl Alcohol—Skin | 400 | 980 | 500 | 1225 |
| Stoddard Solvent | 100 | 525 | — | 1050 |
| Toluene | 50 | 375 | — | 560 |
| Trichloroethylene | 50 | 270 | 100 | 1080 |
| Turpentine | 100 | 560 | — | 840 |
| Xylene (Xylol) | 100 | 435 | 150 | 655 |

[1] TLV-TWA (Threshold Limit Value—Time Weighted Average): The time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect.
[2] TLV-STEL (Threshold Limit Value—Short Term Exposure Limit): The maximum concentration to which workers can be exposed for a short time without suffering from irritation, chronic or irreversible tissue damage, or narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency, and provided that the daily TLV-TWA is not exceeded. Exposures above the TLV-TWA up to STEL should not be longer than 15 minutes and should not occur more than four times per day. There should be at least 60 minutes between successive exposures in this range.
[3] In general, the aromatic hydrocarbon content will determine what TLV applies.
[4] Reprinted from the American Conference of Governmental Industrial Hygienists booklet entitled "Threshold Limit Values for Chemical Substances and Physical Agents, Biological Exposure Indices" 1999 edition. These TLVs are revised annually. Note that OSHA limits may be different (sometimes lower). Therefore, ACGIH recommendations can sometimes be illegal.

phosphate per liter of water (2 oz/gal), to which is also added soap or other suitable detergent at 8 to 15 grams per liter (one to two ounces per gallon). This solution is best used hot; if used cold, it may be advisable to increase the concentration. This solution is suitable for spraying or scrubbing; if used in dip tanks, the concentration may be tripled. If not washed from the surface, this mixture will soften and eventually loosen most paints.

A soap film left on the surface is just as damaging to the paint bond as is an oil or grease film; therefore the surface should be thoroughly washed (preferably with hot water under pressure) to remove this soap and other residue. Moreover, all alkali must be thoroughly removed from the surface or the new paint may be saponified and damaged by it. To test the effectiveness of the wash, universal pH test paper should be placed against the wet steel. The pH of the washed surface should be no greater than the pH of the wash water.

Alkaline cleaners must be used with caution since bad burns may result from contact with some solutions. Particular care should be paid to protecting the eyes of workers; safety goggles or eye shields should be worn. Rubber gloves should be worn if the solutions will contact workers' hands. Where alkaline cleaning compounds are sprayed, respirators should be worn.

**5.1.3 Emulsion Cleaners:** Emulsion cleaners usually contain oil soluble soaps or emulsifying agents along with kerosene or mineral spirits. They are usually supplied as a concentrate which may be thinned with kerosene or mineral spirits and sprayed on the surface to be cleaned. They are emulsified by the action of water under pressure and washed away along with oil, grease, and other contaminants. They may be diluted with water, emulsified, and used in that condition. In any event, the directions of the manufacturer

Provided by : www.spic.ir Licensee: NISOC Library

should be followed.

A residue of emulsion is almost always left on the surface. This residue will leave a thin film of oil on the surface. If the paint to be applied cannot tolerate a slight amount of oil, the residue must be washed from the surface by steam, hot water, detergents, solvents, or alkaline cleaning compounds.

Alkaline emulsion cleaners, which combine the advantages of the alkaline cleaners and the emulsion cleaners, are available.

**5.1.4 Steam Cleaning:** Steam cleaning may utilize either steam, hot water under pressure, or both.

The steam and hot water, when used to clean the surface, are usually used with a detergent and sometimes also with an alkaline cleaner. The steam and hot water themselves tend to remove the oils, greases, and soaps by thinning them with heat, emulsifying them, and diluting them with water. It can then be easily removed by further washing. When detergent is used, its higher affinity for the metal also causes the oil, grease and, in some cases, even the paint to loosen, thereby increasing the rate of cleaning.

The new paint will not adhere to the metal if any of the oil, grease, soap, detergent, or alkali is left on the surface. A final washing with clean water is therefore always necessary.

**5.1.5 Threshold Limit Values:** For threshold limit values of common cleaning solvents see the American Conference of Governmental Industrial Hygienists (ACHGIH) booklet entitled "1999 TLVs and BEIs, Threshold Limit Values for Chemical Substances and Physical Agents, Biological Exposure Indices" (see Table 2).

**5.1.6 Paint Removal:** Although not addressed in SSPC-SP 1, many of the methods used to clean the surface may actually remove paint. A strong solvent used in solvent cleaning may cause old paint to disbond. The adhesive nature of the old paint is reduced by chemical action on the paint. Where complete paint removal is the primary object, caustic soda (sodium hydroxide) or a commercial paint stripper may be used. Steam can be used to remove old paint by cooking the vehicle of the old paint so that it loses its strength and its bonding to the metal. Information on chemical stripping can be found in the technology update SSPC-TU 6, "Chemical Stripping of Organic Coatings from Steel Structures."

**5.2 SSPC-SP 2, "HAND TOOL CLEANING":** Hand tool cleaning is a method of surface preparation often used for normal atmospheric exposures, for interiors, and for maintenance painting when using paints with good wetting ability. Hand cleaning will remove loose rust, loose paint, and loose mill scale but will not remove all residue of rust or intact mill scale. For cleaning small, limited areas prior to maintenance priming, hand cleaning will usually suffice.

It is important to follow the good practices outlined in this hand tool cleaning specification in order to minimize failures or to avoid unnecessarily stringent specifications for the preparation of surfaces which will be exposed in mild environments. Care in hand tool cleaning is also especially important if the prime coat is to be applied by spray, because a sprayed coating may bridge gaps and crevices, whereas brushing works the paint into these areas.

The hand tool cleaning specification requires that oil and grease, along with any salts, be removed as specified in SSPC-SP 1, "Solvent Cleaning" prior to hand tool 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.

**5.2.1 Loose Rust, Mill Scale, and Paint:** Determination of the degree of cleaning required to comply with SSPC-SP 2 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 lifted with a dull putty knife, a somewhat subjective criterion.

One definition of a dull putty knife is: "A dull putty knife is defined as a commercially available putty knife consisting of a flexible metal blade solidly affixed to a handle. The width of the blade at the point of contact with the surface shall be 1 to 1.5 inches. The edge of the blade at the point of contact shall be in the 'as purchased' condition, and shall not be altered by grinding, sanding, or any other means that would affect the contour of the edge. The putty knife shall not be used if the edge is nicked or gouged, or if dry paint or other material is present along the edge that would prevent the blade from making intimate contact with the surface. A blade containing surface scratches from previous use is acceptable. The putty knife shall be used at an approximately 45 degree angle to the surface or lower in an attempt to work it under the edge of material being tested. The width of the blade, not either of the corners, shall be used for the testing."

Another possible solution to determining what exactly constitutes "loose paint" is to establish a standard of cleaning through use of a specified cleaning procedure in which the type of tool, 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 resolving differences of opinion as to whether or not the surface has been properly cleaned.

**5.2.2 Visual Standards:** If mutually agreed upon, SSPC-VIS 3, ISO 8501-1, or other visual references may be used to supplement the cleaning criteria of this specifica-

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 3**
**Comparison of SSPC and ISO Surface Preparation Standards**

| Surface Preparation Standard | | Initial Condition of Steel | | Pictorial Standard | |
|---|---|---|---|---|---|
| **SSPC/NACE** | **ISO** | **SSPC/ISO** | **Description** | **SSPC-VIS 1** | **ISO 8501-1** |
| SP 5/NACE No. 1 White Metal Blast Cleaning | Sa 3 | Rust Grade A | intact millscale | A SP-5, A SP 5-N1, A SP 5-N2, A SP 5-N3, A SP 5-M1, A SP 5-M2 A SP 5-M3 (#) | A Sa 3** |
| | | Rust Grade B | partially rusted millscale | B SP-5 | B Sa 3** |
| | | Rust Grade C | 100% rusted, no pits | C SP-5 | C Sa 3** |
| | | Rust Grade D | rusted and pitted | D SP-5 | D Sa 3 |
| SP 10/NACE No. 2 Near White Blast Cleaning | Sa 2 1/2 | Rust Grade A | intact millscale | A SP-10 | A Sa 2 1/2 |
| | | Rust Grade B | partially rusted millscale | B SP-10 | B Sa 2 1/2 |
| | | Rust Grade C | 100% rusted, no pits | C SP-10 | C Sa 2 1/2 |
| | | Rust Grade D | rusted and pitted | D SP-10 | D Sa 2 1/2 |
| SP 6/NACE No. 3 Commercial Blast Cleaning | Sa 2 | Rust Grade A | intact millscale | * | * |
| | | Rust Grade B | partially rusted millscale | B SP-6 | B Sa 2** |
| | | Rust Grade C | 100% rusted, no pits | C SP-6 | C Sa 2 |
| | | Rust Grade D | rusted and pitted | D SP-6 | D Sa 2 |
| SP 7/NACE No. 4 Brush-Off Blast Cleaning | Sa 1 | Rust Grade A | intact millscale | * | * |
| | | Rust Grade B | partially rusted millscale | B SP-7 | B Sa 1 |
| | | Rust Grade C | 100% rusted, no pits | C SP-7 | C Sa 1 |
| | | Rust Grade D | rusted and pitted | D SP-7 | D Sa 1 |
| SP 14/NACE No. 8 Industrial Blast Cleaning | N/A | Rust Grade A | intact millscale | * | |
| | | Rust Grade B | partially rusted millscale | * | B Sa 2** |
| | | Rust Grade C | 100% rusted, no pits | * | |
| | | Rust Grade D | rusted and pitted | * | |
| **SSPC** | **ISO** | **SSPC** | | **SSPC-VIS 3** | **ISO 8501-1** |
| SP 2 Hand Tool Cleaning | St 2 | Rust Grade A | intact millscale | A SP2 | * |
| | | Rust Grade B | partially rusted millscale | B SP2 | B St 2 |
| | | Rust Grade C | 100% rusted, no pits | C SP2 | C St 2 |
| | | Rust Grade D | rusted and pitted | D SP2 | D St 2 |
| | | Condition E | paint mostly intact | E SP2 | * |
| | | Condition F | zinc-rich paint | F SP2 | * |
| | | Condition G | deteriorated paint over millscale | G SP2 | * |
| SP 3 Power Tool Cleaning | St 3 | Rust Grade A | intact millscale | A SP3/PWB, A SP3/SD, A SP3/NG | * |
| | | Rust Grade B | partially rusted millscale | B SP3/PWB, B SP3/SD, B SP3/NG | B St 3 |
| | | Rust Grade C | 100% rusted, no pits | C SP3/PWB, C SP3/SD, C SP3/NG | C St 3 |
| | | Rust Grade D | rusted and pitted | D SP3/PWB, D SP3/SD, D SP3/NG | D St 3 |
| | | Condition E | paint mostly intact | E SP3/PWB, E SP3/SD, E SP3/NG | * |
| | | Condition F | zinc-rich paint | F SP3/PWB, F SP3/SD, F SP3/NG | * |
| | | Condition G | deteriorated paint over millscale | G SP3/PWB, G SP3/SD, G SP3/NG | * |
| SP 11 Power Tool Cleaning to Bare Metal | | Rust Grade A | intact millscale | A SP11 | * |
| | | Rust Grade B | partially rusted millscale | B SP11 | * |
| | | Rust Grade C | 100% rusted, no pits | C SP11 | * |
| | | Rust Grade D | rusted and pitted | D SP11 | * |
| | | Condition E | paint mostly intact | E SP11, E SP11/R | * |
| | | Condition F | zinc-rich paint | F SP11, F SP11/R | * |
| | | Condition G | deteriorated paint over millscale | G SP11 | * |

SSPC-VIS 1 contains photographs for SP 5, SP 6, SP 7 and SP 10. * = no photograph

SSPC-VIS 3 contains photographs for SP 2, SP 3 and SP 11.

# Alternate non-metallic abrasives: A SP 5-N1, A SP 5-N2, A SP 5-N3

# Alternate metallic abrasives: A SP 5-M1, A SP 5-M2, A SP 5-M3

ISO standards Sa 3, Sa 2 1/2, Sa 2, Sa 1, St 2 and St 3 approximate the corresponding SSPC standards.

**ISO 8501-1 photographs (1978 through 1989 printing) may not adequately illustrate the corresponding SSPC surface preparation.

ISO photograph illustrating B Sa 2 shows dark areas that could be interpreted as millscale and, therefore, represents SSPC-SP 14 and does not represent SSPC-SP 6.

ISO photographs illustrating A Sa 3, B Sa 3 and C Sa 3 do not adequately illustrate the surface texture of typically blast cleaned steel.

The United Kingdom Standard BS 7079 Part A1 is equivalent to ISO 8501-1 and depicts the degrees of cleanliness of unpainted steel. BS 7079 Part A2 is equivalent to ISO 8501-2 and depicts the same degrees of cleanliness of previously painted steel.

Provided by : www.spic.ir Licensee: NISOC Library

tion. Table 3 gives the correlation between the SSPC and the ISO pictorial standards.

**5.3 SSPC-SP 3, "POWER TOOL CLEANING":** Similar to hand tool cleaning, power tool cleaning removes loose rust, loose mill scale, and loose paint. Intact materials may remain. Power tools use electrical and pneumatic equipment to provide faster cleaning. They include sanders, wire brushes or wheels, chipping hammers, scalers, rotating flaps (rotopeen), needle guns, and right angle or disk grinders. Some have high efficiency particulate air filter (HEPA) vacuum lines attached to reduce air pollution and collect debris produced in the cleaning operation. Power tools clean by impact, abrasion, or both. Cleaning of metal surfaces is less expensive using power tools than using hand tools. Also, less particulate contamination of the environment occurs than from abrasive blasting. Thus, power tools are used frequently for spot cleaning of damaged coatings, where contamination of adjacent areas by abrasive is unacceptable, and when a surface-tolerant coating such as oil-based paint is to be used.

The power tool cleaning specification requires that oil and grease, along with any salts, be removed as specified in SSPC-SP 1, "Solvent Cleaning" prior to power tool 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 off with clean, dry, oil-free compressed air, brushing, or vacuum cleaning are satisfactory methods.

Care is necessary in the use of power tools to prevent excessive roughening of the surface as ridges and burrs can contribute to paint failure because sharp edges may not be protected by adequate thickness of paint. Excessive power wire brushing can also be detrimental to the performance of the paint since the surface (particularly mill scale) is easily burnished to a smooth, slick finish to which paint will not adhere.

**5.3.1 Loose Rust, Mill Scale, and Paint:** 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 lifted with a dull putty knife, a somewhat subjective criteria.

One possible solution is to establish a standard of cleaning through use of a specified cleaning procedure in which the type of tool, force, speed, etc., are all 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 of cleaning is not in question. The standard is of value in resolving differences of opinion as to whether or not the surface has been properly cleaned.

**5.3.2 Visual Standards:** If mutually agreed upon, SSPC-VIS 3, ISO 8501-1, or other visual references may be used to supplement the cleaning criteria of this specification. Table 3 gives the correlation between the SSPC and the ISO pictorial standards.

**5.4 SSPC-SP 4, "FLAME CLEANING OF NEW STEEL":** This specification was discontinued in 1982.

**5.5 SSPC-SP 5/NACE No. 1, "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 will 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 a project specification includes maintenance painting, if White Metal Blast Cleaning is specified, it will apply to the entire surface.

**5.5.1 Visual Standards:** If mutually agreed upon, SSPC-VIS 1-89 or other visual references may be used to supplement the cleaning criteria of this specification. Table 3 gives the correlation between the SSPC and the ISO pictorial standards. When using the photographic standards, it should be recognized that the color or hue of the cleaned surface may appear different than the photographs due to the nature of the steel, the abrasives used, the presence of existing coatings, and other factors.

**5.6 SSPC-SP 6/NACE No. 3, "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 will permit a great deal of staining from rust, mill scale, or previously applied paint to remain. The surface will not necessarily be uniform in color, nor will all surfaces be uniformly clean. The advantage of Commercial Blast Cleaning lies in the lower cost for providing a degree of surface preparation that should be suitable for the majority of cases where blast cleaning is believed to be necessary. However, if it is possible that Commercial Blast Cleaning will result in a surface unsatisfactory for the service, then Near-White Blast Cleaning or White Metal Blast Cleaning should be specified.

Provided by : www.spic.ir Licensee: NISOC Library

When a project specification includes maintenance painting, if Commercial Blast Cleaning is specified, it will apply to the entire surface. If it is intended that some of the existing coating be permitted to remain (e.g. because it is thin, well adherent, and compatible with the new coating system), the contract documents should stipulate the extent of the surface to be cleaned in accordance with this specification. SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," cover additional maintenance painting procedures.

**5.6.1 Visual Standards:** If mutually agreed upon, SSPC-VIS 1-89 or visual references may be used to supplement the cleaning criteria of this specification. Table 3 gives the correlation between the SSPC and the ISO pictorial standards. When using the photographic standards, it should be recognized that the color or hue of the cleaned surface may appear different than the photographs due to the nature of the steel, the abrasives used, the presence of existing coatings, and other factors.

**5.7 SSPC-SP 7/NACE No. 4, "BRUSH-OFF BLAST CLEANING":** Brush-Off Blast Cleaning should be employed when the environment is mild enough to permit tight mill scale, tight paint (if the surface was previously painted), and tight rust to remain on the surface. The surface resulting from this method of surface preparation should be free of all loose mill scale, loose paint, and loose rust. The small amount of rust remaining should be an integral part of the surface. The surface should be sufficiently abraded to provide a good anchor for paint. The low cost of this method may result in economical protection in mild environments.

It is not intended that Brush-Off Blast Cleaning be used for very severe surroundings. Brush-Off Blast Cleaning is generally intended to supplant power tool cleaning where facilities are available for blast cleaning. With this method of surface preparation, as with any other, it is understood that the rate of cleaning will vary from one part of the structure to another depending upon the initial condition of the surface. Because of the high rate of cleaning, the cost is low relative to the higher grades of blast cleaning. Paints which are used should have a fair degree of wetting because of the material that is allowed to remain on the surface.

When a project specification includes maintenance painting, if Brush-Off Blast Cleaning of the entire surface is specified, the existing coating being cleaned should be compatible with the new coating system and should be of adequate integrity to withstand the impact of the abrasive. If a substantial amount of the coating will be removed by this method, then a higher level of cleaning should be specified (e.g. Commercial Blast Cleaning). 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.

**5.7.1 Visual Standards:** If mutually agreed upon, SSPC-VIS 1-89 or other visual references may be used to supplement the cleaning criteria of this specification. Table 3 gives the correlation between the SSPC and the ISO pictorial standards.

**5.8 SSPC-SP 8, "PICKLING":** Pickling is considered a desirable method of removing rust and mill scale from structural shapes, beams, and plates when the cost of such removal is felt to be justified. Properly accomplished, pickling produces a surface that will promote long paint life with most coatings, but pickling is most commonly associated with hot dipped galvanizing.

Where production is sufficiently high to keep the equipment in use, pickling results in low cost shop preparation. It is impractical for field use.

Facilities are extremely limited for pickling of large fabricated members or large structural beams. However, there are a number of facilities for large steel plates and structural members not exceedingly long. Small scale pickling facilities are widely available.

Hydrochloric acid dissolves scale faster than sulfuric acid, but hydrochloric acid is seldom heated because of the extreme difficulty associated with the fumes which evolve upon heating. Any acid which is used should be used with a suitable inhibitor. Considerable use is made of the duplex type of pickling where sulfuric acid is used to remove the rust and scale, and phosphoric acid is used for a final phosphate treatment. Special precautions including fresh water rinsing are necessary to remove residues of unreacted sulfuric or hydrochloric acid.

Design of fabricated steel may require special consideration to eliminate pockets or crevices which trap acid during pickling. This may be avoided by pickling in phosphoric acid. Pickled steel, like blast cleaned steel, should be painted as soon as possible after cleaning. A more detailed discussion of pickling is available in Volume 1 of the SSPC Painting Manual.

**5.9 SSPC-SP 9, "WEATHERING FOLLOWED BY BLAST CLEANING":** This specification was discontinued in 1971. Weathering prior to blast cleaning has been found to be a very harmful practice, especially in corrosive environments, since deleterious surface impurities are much more difficult to remove after weathering away of mill scale.

**5.10 SSPC-SP 10/NACE No. 2, "NEAR-WHITE 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

Provided by : www.spic.ir Licensee: NISOC Library

vestiges of streaks and shadows. 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 Metal 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 completely 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 to 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 large number of visual observations and a limited number of light reflectivity measurements. It is hoped that the amount of surface impurity can be quantified 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 a project specification includes maintenance painting, if Near-White Blast Cleaning is specified, it will apply to the entire surface. If it is intended that some of the existing coating be permitted to remain (e.g. because it is thin, well adherent, and compatible with the new coating system), the contract documents should stipulate the extent of the surface to be cleaned in accordance with this specification. SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," cover additional maintenance painting procedures.

**5.10.1 Visual Standards:** If mutually agreed upon, SSPC-VIS 1-89 or visual references may be used to supplement the cleaning criteria of this specification. Table 3 gives the correlation between the SSPC and the ISO pictorial standards. When using the photographic standards, it should be recognized that the color or hue of the cleaned surface may appear different than the photographs due to the nature of the steel, the abrasives used, the presence of existing coatings, and other factors.

**5.11 SSPC-SP 11, "Power Tool Cleaning to Bare Metal":** Power tool cleaning to remove tightly adherent material produces a surface which is visibly free from all rust, mill scale, and old coatings, and which has a surface profile. It produces a greater degree of cleaning than SSPC-SP 3, "Power Tool Cleaning," (which does not remove tightly adherent material) and may be considered for coatings requiring a bare metal substrate.

The surfaces prepared according to this specification are not to be compared to surfaces cleaned by abrasive blasting. Although this method produces surfaces that "look" like nearwhite or commercial blast, they are not necessarily equivalent to those surfaces produced by abrasive blast cleaning as called for in SSPC-SP 10 (near-white) or SP 6 (commercial).

The SSPC specification "Power Tool Cleaning to Bare Metal" helps to bridge the gap between the marginal surface preparation described in SP 2 (hand tool), SP 3 (power tool), and SP 7 (brush-off) and the more thorough cleaning described in SP 6 (commercial), SP 10 (near-white), and SP 5 (white metal). It gives the specifier an opportunity to select a method of cleaning suitable for certain coatings in areas where abrasive blasting is prohibited or not feasible. Examples of circumstances where this specification may be applied are as follows:

- touch-up of welded or damaged areas of erection assemblies;
- reducing volume of hazardous waste produced by abrasive blasting;
- cleaning around sensitive equipment or machinery.

**5.11.1 Power Tools and Cleaning Media:** A power tool cleaning system consists of a surface cleaning medium for abrading the surface and a powered tool for driving that medium. The specification distinguishes between media that clean the surface and those that produce a profile. Similarly, power tools are classified as surface cleaning type or profile producing type.

Surface cleaning power tools are those that drive two main classes of surface cleaning media: 1) non-woven abrasive wheels and discs; 2) coated abrasive discs, flap wheels, bands, or other coated abrasive devices.

Profile producing power tools are described as those on which rotary impact or peening media are mounted, and those on which steel needles (needle guns) are mounted, although other tools and media that can produce the appropriate profile are acceptable. In instances where a profile already exists, such as on previously painted surfaces, only surface cleaning power tools and media may be required, so long as the appropriate degree of cleanliness is created without reducing the profile to less than 25 micrometers (one mil). Where an existing profile is reduced to less than 25 micrometers (one mil) in the process of cleaning, surface profile power tools are also required to be used to restore the appropriate profile.

Where there is no existing profile, then both cleanli-

Provided by : www.spic.ir Licensee: NISOC Library

ness and profile must be produced as specified. This may require using both kinds of tools and media, although in some cases a surface profiling tool/medium may adequately clean the surface without requiring a separate cleaning operation with surface cleaning tools/media.

Cleaning of metal surfaces is usually faster and less expensive using abrasive blasting than using power tools, without considering the cost of mobilization and containment for the control of dust and debris. However, power tools are used frequently for spot cleaning of damaged coatings where contamination of adjacent areas by abrasive is unacceptable. Less particulate contamination of the environment occurs than from abrasive blasting. Misuse of power tools on metals produces a burnished rather than a textured surface that compromises coating adhesion.

**5.11.2: Power Tools With Vacuum Shrouds:** Special power tools may also have HEPA vacuum lines attached to reduce air pollution and to contain the debris generated at the point-source during coating removal. The vacuum shroud surrounds only the tool itself, providing a localized containment of the debris at the point of generation.

The method of operation of vacuum shrouded tools is similar to that of non-vacuum shrouded tools. This is difficult when cleaning irregular surfaces. As a result, special custom shrouds can be fitted onto the ends of the tools. Some tools however, are not amenable to shrouds, and therefore the collection of debris is not as efficient. A surface can be cleaned to comply with either SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 11, "Power Tool Cleaning to Bare Metal," using these vacuum shrouded tools.

**5.11.3 Visual Standards:** If mutually agreed upon, SSPC-VIS 3 or other visual standard may be used to supplement the cleaning criteria of this specification. Table 3 lists the SSPC-VIS 3 photographs that correspond to various initial surface conditions. SSPC-VIS 1 and ISO 85011 are not suitable for assessing surfaces cleaned to bare metal by power tools.

**5.12 SSPC-SP 12/NACE No. 5, "SURFACE PREPARATION AND CLEANING OF STEEL AND OTHER HARD MATERIALS BY HIGH- AND ULTRAHIGH-PRESSURE WATER JETTING PRIOR TO RECOATING":** As is the case with dry abrasive blast cleaning, high-pressure water jetting (HP WJ) and ultrahigh- pressure water jetting (UHP WJ) can be used to prepare surfaces to various degrees of cleanliness. Water jetting is used when abrasive blasting is not possible or when it is necessary to remove a high percentage of soluble salt contamination. Claims have been made that, if the job is considered as a whole, HP WJ and UHP WJ are economically competitive with dry abrasive blasting. Water jetting does not produce a profile. However, if a profile exists under old paint that is being removed, the original profile can be restored by water jetting. Joint technical report SSPC-TR 2/NACE 6G198, "Wet Abrasive Blast Cleaning," discusses wet methods using abrasive.

Water cleaning uses pressures less than 70 Mpa (10,000 psi) and high-pressure water jetting (HP WJ) uses pressures above this value. Ultrahigh-pressure water jetting (UHP WJ) uses pressures above 170 Mpa (25,000 psi). Some members of the water jetting industry want to define UHP WJ to be above 210 MPa (30,000 psi).

**5.12.1 Surface Cleanliness:** SSPC-SP 12 defines four degrees of VISUAL cleanliness which can be summarized as follows:

- WJ-1 Clean to the bare substrate; the most thorough level
- WJ-2 Almost clean to the bare substrate; very thorough cleaning; randomly dispersed visible stains of previously existing rust, paint, and foreign matter is allowed on only 5% of the surface
- WJ-3 Thorough cleaning; randomly dispersed visible stains of previously existing rust, paint, and foreign matter is allowed on only one-third of the surface
- WJ-4 All loose material is uniformly removed

These four conditions of water jetting were meant to parallel the four degrees of abrasive blast cleaning SSPC-SP 5 (white metal), SSPC-SP 10 (near-white), SSPC-SP 6 (commercial), and SSPC-SP 7 (brush-off).

Since one of the advantages of water jetting is the removal of soluble contaminants, SSPC-SP 12 defines three levels of NONVISUAL surface cleanliness based on the amount of water-soluble chlorides, iron-soluble salts, and sulfates:

- SC-1 No salts detected
- SC-2 Less than 7 $\mu g/cm^2$ chloride ion contaminants, 10 $\mu g/cm^2$ ferrous ion, and 17 $\mu g/cm^2$ sulfate ion
- SC-3 Less than 50 $\mu g/cm^2$ chloride and sulfate contaminants

Methods for measuring the amount of salt on the surface are described in SSPC-TU 4, "Field Methods for Retrieval and Analysis of Soluble Salts on Substrates." The choice of visual and nonvisual cleanliness is determined by the existing condition of the surface, the coating to be applied, and the exposure environment.

**5.12.2 Flash Rusting:** With any wet method of surface preparation, the cleaned surface will eventually exhibit a rust bloom or flash rust as the surface dries. Non-uniform rusting with areas of heavy rust usually indicates the pres-

Provided by : www.spic.ir Licensee: NISOC Library

ence of soluble salts on the surface. A uniform rust bloom may be an acceptable surface to paint. Visible flash rusting can be light, medium, or heavy. The coating manufacturer must be consulted to determine the extent of rust bloom that their coating can tolerate for the given exposure. Inhibitors can be added to the water to prevent flash rusting, but the coating manufacturer must be consulted to verify compatibility with the level of inhibitor used.

**5.12.3 Visual Standards:** If mutually agreed upon, SSPC-VIS 4 (I) or other visual references may be used to supplement the cleaning criteria of this specification. SSPC-VIS 4 (I)contains photographs showing steel of original condition of rust grade C cleaned to WJ-2 and WJ-3, each with light, medium, or heavy flash rusting. A parallel set of photographs is given for original condition of rust grade D. When using the photographic standards, it should be recognized that the color or hue of the cleaned surface may appear different than the photographs due to the nature of the steel, the presence of existing coatings, and other factors.

**5.13 SSPC-SP 13/NACE NO. 6, "SURFACE PREPARATION OF CONCRETE":** This standard gives requirements for surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems. The requirements of this standard are applicable to all types of cementitious surfaces including cast-in-place concrete floors and walls, precast slabs, masonry walls, and shotcrete surfaces.

An acceptable prepared concrete surface should be free of contaminants, laitance, loosely adhering concrete, and dust, and should provide a sound, uniform substrate suitable for the application of protective coating or lining systems. When required, a minimum concrete surface strength, maximum moisture content, and surface profile range should be specified in the procurement documents.

This standard contains sections on definitions, inspection procedures before surface preparation, the methods of surface preparation, inspection, and acceptance criteria for light service and for severe service.

**5.14 SSPC-SP 14/NACE No. 8, "INDUSTRIAL BLAST CLEANING":** Industrial blast cleaning is used when the objective is to remove most of the coating, mill scale, and rust, but the extra effort required to remove every trace of these materials is determined to be unwarranted. Industrial blast cleaning provides a greater degree of cleaning than SSPC-SP 7 (brush-off) but less than SSPC-SP 6 (commercial).

The difference between an industrial blast and a brush-off blast is that the objective of a brush-off blast is to allow as much of an existing coating to remain as possible, while the purpose of the industrial blast is to remove most of the coating. The industrial blast allows defined mill scale, coating, and rust to remain on less than ten percent of the surface and allows defined stains to remain on all surfaces. A commercial blast provides a higher level of cleaning, and the surface is free of mill scale, rust, and coatings, allowing only random staining to remain on no more than 33 percent of each 9 $in^2$ (60 $cm^2$) increment of the surface.

**5.14.1 Visual Standards:** If mutually agreed upon, visual references may be used to supplement the cleaning criteria of this specification. SSPC has not yet prepared a visual reference for this recently issued standard. ISO 8501-1:1988 has a photograph, B Sa 2, that appears to have islands of mill scale remaining and therefore would conform to SSPC-SP 14. Standard reference photographs of previously painted steel depicting SSPC-SP 14 have not yet been prepared.

## 6. Selection of Abrasives, Blast Cleaning Parameters, and Equipment

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

- The nature of the steel being cleaned, i.e., the hardness 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, "Surface Profile for Anti-Corrosion Paints," (SSPC 74-01).
- The type of blast cleaning systems which may be employed, e.g., centrifugal wheel or air blast recirculating abrasive systems, or open nozzle airblasting with expendable abrasives.

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

Non-traditional blast cleaning media may be expendable or recyclable. Such materials include sponge, dry ice, sodium bicarbonate and ice crystals. All require specialized equipment and may or may not create a surface profile.

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.

**6.1 ABRASIVE CHARACTERISTICS:** Selecting the

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 4**
**PHYSICAL DATA ON NON-METALLIC ABRASIVES**

| | Hardness (Mohs) | Shape | Specific Gravity | Bulk Density | | Color | Free Silica (wt. %) | Degree of Dusting | Reuse |
|---|---|---|---|---|---|---|---|---|---|
| | | | | lb/ft³ | kg/m³ | | | | |
| **Naturally Occurring Abrasives** | | | | | | | | | |
| Silica Sand | 5 | Rounded | 2 to 3 | 100 | 1600 | White | 90 + | High | Poor |
| Heavy Mineral Sand | 5 to 7 | Rounded | 3 to 4 | 125 | 2000 | Variable | < 5 | Medium | Good |
| Flint | 6.5 to 7 | Angular | 2 to 3 | 80 | 1300 | Lt. Gray | 90 + | Medium | Good |
| Garnet | 7 to 8 | Angular | 4 | 145 | 2300 | Pink | Nil | Medium | Good |
| Zircon | 7.5 | Cubic | 4.5 | 185 | 3000 | White | Nil | Low | Good |
| Novaculite | 4 | Angular | 2.5 | 100 | 1600 | White | 90+ | Low | Good |
| **By-Product Abrasives** | | | | | | | | | |
| Boiler Slag | 7 | Angular | 2.8 | 85 | 1400 | Black | Nil | High | Poor |
| Copper Slag | 8 | Angular | 3.3 | 110 | 1800 | Black | Nil | Low | Good |
| Nickel Slag | 8 | Angular | 2.7 | 85 | 1400 | Green | Nil | High | Poor |
| Walnut Shells | 3 | Cubic | 1.3 | 45 | 720 | Brown | Nil | Low | Poor |
| Peach Shells | 3 | Cubic | 1.3 | 45 | 720 | Brown | Nil | Low | Poor |
| Corn Cobs | 4.5 | Angular | 1.3 | 30 | 480 | Tan | Nil | Low | Good |
| **Manufactured Abrasives** | | | | | | | | | |
| Silicon Carbide | 9 | Angular | 3.2 | 105 | 1700 | Black | Nil | Low | Good |
| Aluminum Oxide | 8 | Blocky | 4.0 | 120 | 1900 | Brown | Nil | Low | Good |
| Glass Beads | 5.5 | Spherical | 2.5 | 100 | 1600 | Clear | 67 | Low | Good |
| Crushed Glass | 6 to 8 | Irregular | 2.5 | 63 to 91 | 1000-1500 | Gray | 67 | Low | Poor |
| Sodium Bicarbonate | 2.5 | Powder | 2.2 | 60 | 960 | White | Nil | None | Poor |
| Sponge | 0.016 | Granular | 0.29-1.45 | 5 to 25 | 80 to 400 | Various | Nil | Low | Good |
| Plastic Beads | 3.5 | Blocky | | 55 | 880 | Various | Nil | Low | Fair |
| Dry Ice | Nil | Cylinder | 62.4 | 50 | 800 | White | Nil | Low | Poor |

appropriate type of abrasive for the job is important because the type of abrasive can have a significant influence on the appearance of the blast cleaned surface, productivity, and subsequent clean-up. Abrasives vary in hardnesses, particle size distribution, shape, bulk density, friability, waste generation, and recyclability. The following is a discussion of these characteristics and how these characteristics influence abrasive performance. Some physical data on non-metallic abrasives are given in Table 4.

**6.1.1 Hardness:** Metallic abrasive hardness is measured on the Rockwell C scale while non-metallic abrasive hardness is measured on the Mohs scale. Hardness is important because the harder an abrasive, the more profile it is likely to generate.

**6.1.2 Size:** Most abrasive specifications include some form of particle size designation, because particle size plays a major role in productivity and in the subsequent profile generated. The role of abrasive size will be discussed in more detail under the section dealing with productivity.

**6.1.3 Shape:** Abrasive particles range from spherical to sharply angular. Spherical to rounded particles clean by impact, producing a peened surface. Angular to irregularly shaped particles clean by scouring or cutting the surface, producing an etched surface.

**6.1.4 Bulk Density:** The bulk density of an abrasive is a measure of an abrasive's weight per unit volume and is usually expressed in kilograms per cubic meter or pounds per cubic foot. For example, the bulk density of sand is approximately 160 kg/m³ (100 lb/ft³) whereas for steel grit abrasives, it is typically 400 kg/m³ (250 lb/ft³). Bulk density

Provided by : www.spic.ir Licensee: NISOC Library

is important when lifting abrasive filled bulk containers. Using the bulk density values for sand and steel shown above, a 2.8 $m^3$ (100 $ft^3$) container filled with sand weighs 4500 kg (5 tons), whereas the same container filled with steel grit weighs 11,000 kg (12.5 tons).

**6.1.5 Friability/Waste Generation:** Abrasive friability is a measure of an abrasive's resistance to break down on impact. The more friable an abrasive, the greater the tendency for the abrasive to break down on impact, thereby generating more waste and dust.

**6.1.6 Recyclability:** Recyclability is a property of an abrasive that allows it to be reused many times without excessive breakdown. In order to meet the strict cleanliness requirements for recycling, the abrasive must also be able to withstand the rigorous cleaning process for removal of contaminants from the abrasive mix. Most mineral and byproduct abrasives can be recycled one to three times, but they have difficulty meeting the strict cleanliness requirements for recycling. Steel abrasives, on the other hand, show the lowest friability, generate the least amount of waste, can be recycled many times, and meet the strict cleanliness requirements for recycling.

**6.2 FACTORS AFFECTING SURFACE PROFILE:** Surface profile is a measure of surface roughness resulting 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 thickness and generic type of paint to be applied determines the allowable minimum and maximum profile height. The abrasive size is then chosen to achieve that profile. SSPC-AB 1, "Mineral and Slag Abrasives," defines five abrasive grades yielding profile heights from 13 to 150 micrometers (0.5 to 6.0 mils).

SSPC studies have shown that metallic abrasives larger than those which will pass through a #16 screen (ASTM E 11) 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 may be needed. In these cases two coats of primer may be needed instead of the usual one coat. Alternatively, if the nozzle pressure is increased, a smaller size abrasive may remove heavy paint or scale more effectively than a larger abrasive at the lower pressure. Higher nozzle pressures may still produce larger profiles.

Table 5 gives the range of maximum and average maximum profile heights to be expected under normal good operating conditions (wheel and nozzle). At nozzle pressures in excess of 760 kPa (110 psi), the profile may be significantly higher.

Profile comparators are available to aid in estimating the average maximum profile of surfaces blasted with sand, steel grit, and steel shot. Surface profile can also be measured by use of replica tape. Methods for measuring profile are described in ASTM D 4417, "Test Method for Field Measurement of Surface Profile of Blast Cleaned Steel" and in NACE RP0287, "Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape." A report, "Surface Profile for Anti-Corrosion Paints," (SSPC 74-01) is available from SSPC describing methods of measuring profile and relating profile to blast cleaning conditions and to coating performance.

When the abrasive media impacts the surface it generates surface profile. It is this profile or anchor pattern that is necessary for most coating systems to adhere to the substrate. The depth of the profile is controlled by the following parameters:

- Abrasive Size: The larger the abrasive, the larger the profile.
- Abrasive Type: Angular abrasives create a deeper profile than round abrasives of the same size.
- Hardness: The harder the abrasive the deeper the profile.
- Blast Nozzle Air Pressure: The higher the nozzle pressure the deeper the profile.
- Type of Blast Nozzle: A venturi nozzle generates a deeper profile than a straight bore nozzle with the same diameter opening.

**TABLE 5**
**APPROXIMATE PROFILE HEIGHT OF BLASTED STEEL USING DIFFERENT SIZE ABRASIVES**

| Abrasive | Profile height | | | | |
|---|---|---|---|---|---|
| | 25 μm 1 mil | 37 μm 1.5 mil | 50 μm 2 mil | 63 μm 2.5 mil | 75-100 μm 3 - 4 mil |
| Silica sand | 30/60 mesh | 16/35 mesh | 16/35 mesh | 8/35 mesh | 8/20 mesh |
| Steel grit | G80 | G50 | G40 | G40 | G25 |
| Steel shot | S110 | S170 | S280 | S280 | S330 |
| Garnet | 80 mesh | 36 mesh | 36 mesh | 16 mesh | 16 mesh |
| Aluminum oxide | 100 grit | 50 grit | 36 grit | 24 grit | 16 grit |

These profile heights are typical if the nozzle pressure is between 620 and 700 kPa (90 and 100 psi).



Provided by : www.spic.ir Licensee: NISOC Library

- Distance of Blast Nozzle to Surface: The closer to the work the deeper profile.
- Angle of Blast Nozzle to Surface: The greater the angle from the perpendicular to surface, the less the profile.

Altering any of these parameters during the blasting operation could affect profile and surface cleanliness. To avoid undesirable changes in profile and surface cleanliness, blasting trials are recommended before changing any of the parameters noted above.

**6.3 PARAMETERS THAT AFFECT PRODUCTIVITY:** The productivity of abrasive blast cleaning is determined primarily by the eleven parameters described below.

**6.3.1 Particle Size:** Decreasing abrasive particle size can dramatically increase cleaning rate. Increasing abrasive particle size may be necessary to remove heavy coatings and scale. The general rule is to use the smallest size abrasive that will do the job.

**6.3.2 Hardness:** Generally, the harder the abrasive, the better it will perform. However, very hard abrasives shatter on impact expending most of their energy in particle breakdown and dust generation. As with selecting abrasive size, the general rule is to select the minimum abrasive hardness that will effectively do the job.

**6.3.3 Shape:** Rounded particles are most effective in removing brittle coatings such as mill scale, whereas angular or irregular shaped particles are more effective in removing softer coatings such as rust and paint.

**6.3.4 Specific Gravity:** The higher the specific gravity, the more energy a given size abrasive particle will impart to the surface on impact and thus the more productive work it will do. Generally, a higher specific gravity implies a higher bulk density.

**6.3.5 Nozzle Pressure:** The higher the nozzle pressure the more productive the blast operation. For example, for each 7 kPa (1 psi) increase there is a 1.5 percent increase in productivity. Most equipment for dry abrasive blasting has a practical upper limit of 1000 kPa (150 psi). Due to losses, the actual maximum nozzle pressure will be less than this.

**6.3.6 Nozzle Type:** It is important to choose the right nozzle for the job. For example, straight bore nozzles give a tight blast pattern that is best suited for blast cleaning small areas such as hand rails, spot blasting, weld seams, etc. Venturi bore nozzles create a wide blast pattern and are best suited for large area blast cleaning. Venturi bore nozzles increase nozzle velocity by as much as 100% and therefore are 35% more efficient compared to straight bore nozzles of the same diameter.

**6.3.7 Nozzle to Surface Distance:** For optimum cleaning rate the nozzle to surface distance is around 46 cm (18 inches). However, this distance can vary depending on the type of surface contamination being removed, nozzle pressure, abrasive type, and nozzle type.

**6.3.8 Impact Angle:** An 80 to 90 degree angle is best suited for removing mill scale or heavy rust and for cleaning pitted areas; a 45 to 60 degree angle is best for peeling heavy layers of paint or rust; a 60 to 70 degree angle is recommended for general cleaning.

**6.3.9 Abrasive Metering:** Each abrasive type has a different optimum flow rate through the metering valve. Before starting any blast cleaning job, it is important to conduct a test blast with the metering valve set at lean, moderate, and high abrasive flow rates to find the optimum flow for the given abrasive.

**6.3.10 Abrasive Cleanliness:** A clean, dry, dust-free abrasive is essential for optimum productivity. Check the abrasive before starting a job and regularly thereafter for foreign matter, moisture, and dust.

**6.3.11 Embedment:** Some abrasive products, particularly non-metallics, tend to embed in the blast cleaned surface. Conduct a test blast with the abrasive and evaluate the blast cleaned surface to be sure the amount of embedment does not exceed the job specification requirements.

**6.4 ABRASIVE TYPES:** Abrasives, the material in the blasting operation that does the work, can be divided into two major categories: metallic, generally ferrous, abrasives and nonmetallic abrasives. The non-metallic abrasives can be further subdivided into naturally occurring, by-product, or manufactured abrasives.

**6.4.1 Metallic 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 SSPC-AB 3 “Newly Manufactured or Re-Manufactured Steel Abrasives” in terms of hardness, chemical composition, size, and microstructure.

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 on the Rockwell C-scale ($R_c$), 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 to 50 $R_c$, 55 to 60 $R_c$, and 60 to 66 $R_c$. 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.

Provided by : www.spic.ir Licensee: NISOC Library

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 rust grade classifications described in Section 4.1 are:

- Shot: Commonly used on new steel to remove mill scale using centrifugal wheel machines
- Grit (40-50 $R_c$): Most effective on rust grades C and D, but also commonly used for rust grades A and B
- Shot/Grit Mixture (Shot 40-50 $R_c$/Grit 55-60 $R_c$): Used on new steel to remove both mill scale and rust. Shot/grit mixes demand careful attention and close control of abrasive additions by the operator to maintain the shot/grit ratio.

**6.4.2 Non-Metallic Abrasives:** Non-metallic abrasives can be categorized as naturally occurring, by-product, or manufactured. Naturally occurring abrasives include silica sand, olivine sands, staurolite and other minerals, flint, garnet, zirconium, and novaculite. Byproduct abrasives include those from smelters (i.e., nickel or copper slag) and utility generators (coal or boiler slag) and those from agricultural products (e.g., walnut shells, peach shells, or corncobs). Manufactured abrasives include silicon carbide, aluminum oxide, and glass beads.

Commonly used abrasives for surface preparation of steel to be painted are silica sand, coal and smelter slags, staurolite, olivine, and garnet. Some countries have banned the use of abrasives with a high free-silica content because of possible health hazards. The United States military specification MIL-A-22262(SH), “Abrasive Blasting Media, Ship Hull Blast Cleaning,” allows the maximum crystalline silica content of the abrasive to be 1.0 percent by weight. This level of silica corresponds to a Class A abrasive as described in SSPC-AB 1, “Mineral and Slag Abrasives.”

**6.5 BLAST EQUIPMENT:** For the most economical production, the blast cleaning equipment must match the job.

**6.5.1 Conventional Blasting:** Air abrasive blasting equipment has five basic components: air compressor, air hose, blasting machine (sand pot), blast hose, and nozzle. The compressor must be large enough to supply the volume of air needed at the correct pressure, and this depends on factors such as nozzle size, number of nozzles, and length and size of air hose. Nozzles are available in several lengths, designs, sizes of openings, and lining materials. Nozzle lengths of 13 to 20 cm (5 to 8 inches) are generally used for removing tightly adhering rust and scale. Shorter nozzles 8 cm (3 inches) or less are more appropriate for use behind beams and in other inaccessible places.

Where shop cleaning of steel is possible, centrifugal wheel blasting units using recyclable steel abrasive are the most economical. Both centrifugal wheel and air blasting are discussed in detail in Volume 1 of the SSPC Painting Manual.

Non-traditional blast cleaning media (sponge, dry ice, sodium bicarbonate, ice crystals) may be expendable or recyclable and may or may not create a surface profile. All require specialized equipment (see Section 9).

**6.5.2 Vacuum Blasting:** Vacuum blast cleaning is less productive than conventional blast cleaning and therefore is used for small localized areas. Vacuum blast cleaning can achieve the highest levels of surface preparation while minimizing worker exposure to emissions of dust and debris. The tools must be properly operated and fitted with the appropriate shroud in order to maintain the seal between the blast nozzle and the substrate. Compressed air is used to propel abrasive particles against the surface to be cleaned. The blast nozzle is fitted into a localized containment assembly (surrounding the nozzle only) which is equipped with a vacuum. Dust, abrasive, and old paint are sent to a recycler. The cleaned abrasive is returned for re-use. Metallic abrasives such as steel grit, steel shot, or aluminum oxide are used.

**6.5.3 Abrasive Blast Cleaning Above 760 kPa (110 psi):** Over the last several years many blast cleaning operators have been developing techniques that will allow them to blast clean at nozzle pressures greater than 760 kPa (110 psi). The primary driving force has been dramatic increases in productivity. For every 7 kPa (1 psi) increase in nozzle pressure there is a 1.5 percent increase in productivity. For example, going from 690 to 760 kPa (100 to 110 psi) is a 10 percent increase in nozzle pressure but a 15 percent increase in productivity. Going from 690 to 860 kPa (100 to 125 psi) results in a 38 percent increase in productivity.

Another important advantage of higher nozzle pressures is the ability to use finer abrasives to achieve a given profile. Using finer abrasives means more abrasive impacts per unit time, which translates into faster cleaning and higher productivity. Steel abrasives are recommended for high pressure blasting because they do not break down at these elevated pressures. When using non-metallic abrasives at elevated pressures, much of the energy imparted to the abrasive particles is dissipated in the pulverizing of the abrasive particles, thus reducing cleaning efficiency and dramatically increasing dust levels.

## 7. Summary of SSPC Abrasive Specifications

**7.1 SSPC-AB 1, “MINERAL AND SLAG ABRASIVES”:** This specification defines the requirements for selecting and evaluating nonmetallic mineral and slag abrasives used for blast cleaning steel and other surfaces for painting.

Provided by : www.spic.ir Licensee: NISOC Library

The specification defines two types: 1) natural mineral abrasives, including sand, flint, garnet, staurolite, and olivine; and 2) slag abrasives, including coal slag, copper slag or nickel slag. The abrasives covered by the specification are primarily intended for one-time use without recycling.

The abrasives are also classified based on the crystalline silica content and the profile produced by the abrasive. The surface profile is determined by a blasting test conducted on 61 cm x 61 cm (2 ft by 2 ft) steel plates. Other properties stipulated include specific gravity, hardness, weight change on ignition, water-soluble contaminants, moisture content, and oil content.

For a given abrasive type, the surface profile is determined by the size and shape of the abrasive particles. The abrasive supplier is required to furnish a representative sieve analysis of the abrasive used in the profile determination. This sieve analysis then becomes the typical particle size distribution for subsequent delivery of the abrasive. Additional information on physical properties of non-metallic abrasives is given in Table 4.

**7.2 SSPC-AB 2, "SPECIFICATION FOR CLEANLINESS OF RECYCLED FERROUS METALLIC ABRASIVES":** This specification gives the cleanliness requirements for recycled work mix ferrous metallic abrasives. The limits and test methods are given for non-abrasive residue, lead content, water-soluble contaminants, and oil content.

**7.3 SSPC-AB 3, "NEWLY MANUFACTURED OR REMANUFACTURED STEEL ABRASIVES":** This specification defines the physical and chemical requirements for steel abrasives. Abrasive size is determined by the sieve analysis of SAE J444, "Cast Shot and Grit Size Specifications for Peening and Cleaning." Abrasive shape, divided into shot or grit, is determined by the shape of 90 percent of the sample. The minimum specific gravity is 7.0. After 100 cycles in a durability test, 80 percent must be retained on the appropriate take-out screen. Chemical properties include requirements for iron, carbon, manganese, and phosphorous content as well as conductivity and cleanliness.

## 8. Wet Abrasive Blast and Water Jetting Methods

Methods of coating removal which involve water may or may not include abrasive. Several wet abrasive blast methods are described in SSPC-TR 2/NACE 6G198, "SSPC/NACE Joint Technical Report, Wet Abrasive Blast Cleaning." The specification for water jetting without abrasives is the joint surface preparation standard SSPC-SP 12/NACE No. 5, "Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating." The joint visual standard is SSPC-VIS 4(I)/NACE No. 7, "Interim Guide and Visual Reference Photographs for Steel Cleaned by Water Jetting." SSPC and NACE restrict the terms "blast" or "blasting" to refer to processes that involve abrasives. If no abrasives are present, the preferred terms are cleaning or jetting.

In the past, the term "water blasting" has generically referred to the use of 34 to 170 MPa (5,000 to 25,000 psi) water for cleaning where abrasives may or may not be added. Currently in SSPC, the term "water blasting" indicates that an abrasive has been added to the water stream; it is not used as a defined term in either wet abrasive blast or water jetting documents.

**8.1 WATER CLEANING AND WATER JETTING WITHOUT ABRASIVE:** Surface contaminants from a surface can be cleaned with water at pressures from 0.1 to over 300 MPa (15 psi to 45,000 psi). Water cleaning in its most general sense is simply removal of surface contaminants such as dirt, soil, and salts from a surface with liquid water. The definitions of low, high, and ultra-high pressure and the use of "cleaning" compared to "jetting" are based on the nozzle pressure and are related to the water velocity. Pressures below 34 MPa (5,000 psi) are defined as low; pressures above 34 MPa (5,000 psi) are defined as high pressure. The term "jetting" is used when the velocity of the water exceeds 335 m/s (1100 ft/s) which occurs around 70 MPa (10,000 psi). See Table 6.

**8.1.1 Degrees of Cleaning:** Joint surface preparation standard SSPC-SP 12/NACE No. 5 (water jetting) defines four degrees of visual cleaning based on the amount of visible contaminants remaining and three levels of cleanliness based on the amount of nonvisible soluble salt contamination that remains. SSPC-SP 12/NACE No. 5 (water jetting) does not relate water pressure nor volume to the degree of visual cleaning.

The visual appearance of a surface cleaned by water

**TABLE 6**
**DEFINITIONS OF WATER CLEANING AND WATER JETTING**

| | |
|---|---|
| Low-Pressure Water Cleaning (LP WC) | Less than 34 MPa (less than 5,000 psi) |
| High-Pressure Water Cleaning (HP WC) | 34 to 70 MPa (5,000 to 10,000 psi) |
| High-Pressure Water Jetting (HP WJ) | 70 to 170 MPa (10,000 to 25,000 psi) |
| Ultrahigh-Pressure Water Jetting* (UHP WJ) | Over 170 MPa (over 25,000 psi) |

*Joint surface preparation standard SSPC-SP 12/NACE No. 5 is in revision in 2000 and will most likely change the UHP WJ definition to over 210 MPa (30,000 psi) instead of over 170 MPa (25,000 psi).

Provided by : www.spic.ir Licensee: NISOC Library

can appear very different from an abrasive blast. If the coating to be removed is intact, the resultant surface will look like the original blasted surface, but darker and dull. If the coating is breached or there is rust to be removed, the surface can be mottled or very non-uniform. Every defect is revealed. It can show variation in texture, shade, color, tone, pitting, or flaking. A brown-black discoloration of ferric oxide can remain as a tightly adherent thin film on corroded or pitted steel.

Because water cleaning and water jetting are used in maintenance, not on new steel, the coating manufacturer should be contacted for details of coating performance over residual paint, rust, and mill scale.

Water cleaning and water jetting have the advantage of removing soluble salts that can later cause underfilm corrosion or osmotic blistering of the coating. As with any wet cleaning method, it may be necessary to add a soluble salt remover or corrosion inhibitor to the water or a rinse water wash to achieve the desired nonvisual cleanliness.

**8.1.2 Profile:** Because water jetting does not provide an anchor pattern needed for coating adhesion, water cleaning or water jetting is used primarily for recoating or relining projects where there is an adequate preexisting profile. Water alone, under various pressures, can be used to remove coating materials, deleterious amounts of water-soluble surface contaminants, rust, shot-creting spatter, and surface grease and oil. It can not remove tight mill scale or tightly adherent magnetite. An existing profile under the paint or rust can be restored down to the bottom of the pits.

**8.1.3 Water Consumption:** Low pressure water cleaning is often called pressure washing or power washing. Pressure washing of an existing coating is done to remove salts and surface contaminants (chalk, dirt, etc,) prior to "cleaning" the surface for painting. The water may or may not include the use of a soluble salt remover to aid in the removal of salts and surface contaminants. Cleaning steel for coatings can be achieved with water pressures as great as 300 MPa (45,000 psi) or above and water volumes of only 6 to 55 liters (1.5 to 15 gallons) per minute. Caution must be maintained with water cleaning or water jetting to avoid injuries to personnel and structures.

**8.1.4 Equipment:** Vacuum shrouds, remote controls, filtration, and collection, in both manual and non-manual systems, are available. The water stream can be combined with a vacuum system to remove the water from the surface immediately, thereby preventing flash rust. After filtration the water is then recycled. Dust emissions are low because the particulates are wetted and do not disperse in the atmosphere. The environmental risk is low as long as the water is properly contained or collected.

**8.1.5 Flash Rust:** Flash rusting is defined in SSPC-VIS 4(I)/NACE No. 7 "Interim Guide and Visual Reference Photographs for Steel Cleaned by Water Jetting." Flash rust and rust bloom are evaluated separately from visual cleanliness prior to recoating. If the surface is cleaned by water jetting, the uniform rust bloom may not be a problem provided the desired nonvisible cleanliness is achieved and verified by testing. Section 7.3 is a more thorough discussion of flash rusting.

**8.2 WET ABRASIVE BLAST CLEANING:** The methods, equipment, and other features of wet abrasive blast cleaning are described in SSPC-TR 2/NACE 6G198, "Wet Abrasive Blast Cleaning." Two systems for wet abrasive blast cleaning are described: pressurized water/abrasive blasting, which uses water to propel the abrasive, and air/water/abrasive blasting, which uses compressed air to propel the abrasive. The system processes range from mostly abrasive with a small amount of water to mostly water with a small amount of abrasive.

Wet abrasive blasting is a process that can produce surface cleanliness and anchor patterns (surface roughness) similar to those obtained with dry abrasive blasting. The level of surface preparation specified is the same as if dry abrasive blasting was the process being used, that is SSPC-SP 5, SP 10, SP 6, SP 14, and SP 7. However, because the visual appearance of wet abrasive blasted surfaces is not necessarily the same as the visual appearance of dry abrasive blasted surfaces, care and judgment should be exercised by inspectors. There is a separate visual guide under preparation for wet abrasive blasting. Acceptable variations in appearance that do not affect surface cleanliness include variations caused by type of steel, original surface condition, thickness of the steel, weld metal, mill or fabrication marks, heat treating, heat affected zones, blasting abrasives, and differences due to blasting technique.

Surfaces cleaned by wet abrasive blasting typically appear darker and duller in appearance than surfaces cleaned with the same abrasive in dry abrasive blasting. Wide variations in appearance can be observed among abrasives within a given generic class. See SSPC-VIS 1-89 for illustrative photographs for dry blasting.

When the surface is still damp or wet, it will appear darker, and defects and variations in shading are magnified. As the surface dries, streaks will form which are not necessarily depicted in small unit size photographs, but which can be clearly seen on larger areas.

Wetted abrasive should be removed from the substrate after blasting. This is frequently accomplished with a low pressure water cleaning to which a soluble salt remover and/or inhibitor has been added.

**8.2.1 Air/Water/Abrasive Blasting:** Air/water/abrasive blasting is a cleaning method in which water is injected into the air/abrasive stream generated by conventional

Provided by : www.spic.ir Licensee: NISOC Library

airpressurized abrasive blasting equipment, or in which the premixed abrasive/water combination is forced into the blast air stream generated by a conventional air compressor. Other generic terms to describe specific air/water/abrasive blast cleaning methods are water shroud blasting, wet-head blasting, wet blasting, low volume water abrasive blasting, and slurry blasting.

Water helps to remove contaminants from the substrate, to wet the abrasive, and to substantially reduce dispersion of fine particulates (dust). Particulates are often caused by the breakup of the abrasives, surface corrosion products, and paint if the surface has been previously painted. Dust suppression is achieved by thoroughly wetting the abrasive and other particles to encapsulate them with a thin film of moisture. The objective is to remove contaminants and suppress the dusting effect caused by the impact of the abrasive on the substrate, while retaining the blasting characteristics of dry abrasive, including creation of an anchor profile.

The equipment used for wet abrasive blasting generally consists of conventional dry abrasive blasting equipment supplemented with modules to inject water into the abrasive stream, or specialized equipment that creates an abrasive/water slurry that is forced into the compressed blast air stream. Several methods exist for introducing water into the air stream. With radial water injectors (water rings) and coaxial water injectors, water is injected near the blast nozzle. A new hybrid process, introduced after SSPC-TR 2 was published, mixes a conventional abrasive air stream with water jets up to 240 MPa (35,000 psi) at the nozzle. The volume of abrasive can be varied.

With slurry blasters, the water is injected into the air/abrasive stream at some point substantially upstream from the blast nozzle or at the abrasive hopper, rather than at the nozzle. In the low volume, low pressure water abrasive blasting system, four parts of abrasive are wetted with one part of water in a hopper. This slightly wetted abrasive is carried in a conventional compressed air stream and produces results very similar to dry abrasive blasting. There is minimal water run-off.

**8.2.2 Water/Abrasive Blast Cleaning:** The methods, equipment, and other features of water/abrasive blast cleaning are described in SSPC-TR 2/NACE 6G198, "Wet Abrasive Blast Cleaning." Water/abrasive blast cleaning is a cleaning method in which abrasive is injected into the water stream generated by conventional fluid pumps. Other generic terms to describe specific water/abrasive blast cleaning methods are slurry blasting, abrasive water jet (AWJ), or abrasive injected water jetting/blasting (AIWJ).

The typical devices used for this method of cleaning consist of a fluid pump with a Venturi nozzle of some type in which the water flow draws the abrasive into the water stream or the abrasive media is injected into the water stream under pressure. The addition of expendable abrasives to high pressure water jets improves the productivity of the technique, enables the removal of intact materials, and facilitates the creation of a surface profile.

Because the fluid stream is well defined, these devices usually cut a narrow blast pattern. However, a new hybrid process, introduced after SSPC-TR 2 was published, mixes a conventional abrasive air stream using 0.2 to 1.1 kg/min (0.5 to 2.5 pounds/min) with the water jet stream up to 240 MPa (35,000 psi) at the nozzle. It uses both a conventional fluid pump and a compressed air stream and produces a diffuse spread pattern.

**8.3 FLASH RUST AND INHIBITORS:** Steel that is cleaned with water can rust rapidly. The rate of re-rusting will depend on the purity of the water, the amount of oxygen dissolved in the water, the amount of ionic species left on the surface, the temperature, and the drying time. In 1991, G.C. Soltz reported that steel will not rust in 100% relative humidity if all of the salts are removed. [G.C. Soltz,"The Effects of Substrate Contaminants on the Life of Epoxy Coatings Submerged in Sea Water," National Shipbuilding Research Program, March 1991.] Soluble salt removers and/or inhibitors can be added to the water during the cleaning process to reduce the potential of flash rusting. The use of low conductivity water with the removal of all salts (as measured by field tests) will significantly reduce the amount of flash rust. The amount of flash rust also can be significantly reduced with the addition of forced air drying or use of a vacuum shroud which does not allow the water to remain on the surface as it is drying.

Flash rusting or rust bloom is a light oxidation of the steel, which occurs as wetted cleaned steel dries off. Flash rusting can form quickly to change the initial appearance. It is not the rust itself, but the source of the re-rusting that is of concern to the coating manufacturers, as inert iron oxides (rust) are used as pigments. Very dark, splotchy rust spots which appear to be isolated in localized areas usually indicate that ionic contaminants are left in pits, under metal lips, or in crevices. These non-visible contaminants are found to be detrimental to coating performance. A light, easily removed rust bloom is considered inert and a sign of general steel oxidation. Manufacturers can have concerns about performance when their coatings are applied over loose dust or loose rust. The level of rust bloom that can be tolerated in a given environment must be determined for the coating systems by the coating manufacturers.

Flash rusting is not addressed in the dry abrasive blast cleaning standards except in the notes. Re-rusting of dry abrasive blasted steel, as there is little moisture present, is a sign that non-visible contaminants have been left on the steel and is still not tolerated by the coatings manufacturers. G.C. Soltz has found that, for abrasive blasting, coating the surface before it has re-rusted is no assurance that the coating performance will not be compromised. [G.C. Soltz, "Understanding How Substrate Contaminants Affect the

Provided by : www.spic.ir Licensee: NISOC Library

Performance of Epoxy Coatings and How to Minimize Contamination," SSPC 1998 Proceedings, "Increasing the Value of Coatings", pp. 208-219.]

Flash rusting by water is addressed in SSPC-VIS 4(I)/ NACE No. 7, "Interim Guide and Visual Reference Photographs for Steel Cleaned by Water Jetting." The reference photographs depict steel with light, medium, or heavy flash rusting prior to re-coating. Depending on the particular coating and exposure environment, the coating manufacturer may allow flash rusting at one of these levels. The SSPC report, "Maintenance Coating of Weathering Steel," (92-08), found that coatings can perform quite well over a blasted surface that has a uniform rust bloom.

Inhibitors and/or soluble salt removers can be added to the water or to a rinse water to temporarily prevent rust formation. Environmental and health concerns in recent years have prompted changes in the chemistry of rust inhibitors. Acceptable rust inhibitors include polyphosphates, volatile amines, benzoates, nitrites, surface tension reducers, and other proprietary compounds which are formulated in water-borne paints to reduce rust bloom. Additives such as soluble salts or film formers can adversely affect the long-term performance of the coating system. If an additive is used in the water, it is imperative that the user check with the coating manufacturer about the compatibility of the coating with the inhibitor or soluble salt remover. This compatibility can be checked using ASTM D 5367, "Practice for Evaluating Coatings Applied over Surfaces Treated with Inhibitors Used to Prevent Flash Rusting of Steel When Water or Water/Abrasive Blasted." At the present time many coatings manufacturers prefer placing their coatings over light flash rust rather than adding the uncertainty of an inhibitor or soluble salt remover.

## 9. Other Cleaning Methods

**9.1 CHEMICAL STRIPPING:** Paint strippers are frequently used to remove paint from industrial structures. Alkaline strippers are more effective in removing oil-based paints, and solvent type strippers are more effective in removing latex paints. Other coating types require bond breaking strippers which may be composed of a blend of solvents comprised of compounds such as N-methylpyrrolidone (NMP) or dibasic ester (DBE). It may be necessary to use both types to strip alternating layers of oil and latex coatings from a surface. Strippers usually contain a thickener to provide more contact time for solvent or chemical attack on the paint. Some are covered with a sheet of plastic to increase the contact time. Chemical stripping is one method of removing old, lead-containing paint.

An alkaline (caustic) based or solvent based chemical stripper is applied to the surface using trowels, brushes, rollers, or spray application. After the specified dwell time, the stripper is removed using traditional scrapers, although water cleaning or ice blasting can be used. Mill scale and rust are not removed, and a profile is not generated, but an existing profile can be restored.

The specific type of stripper must be selected based upon the generic type of the existing coating system as well as health, safety, and environmental concerns. Some of the strippers require a minimum four hours set time while others may require a full day. In addition, many of the solvent strippers involve chemical reactions which generate heat. This heat must be contained in order for the chemical reaction to continue, which may require covers if ambient temperatures are too low.

Paint strippers, applied to horizonal or vertical surfaces by brush or spray, are covered by Federal Specification TT-R-251, "Remover; Paint (Organic Solvent Type)"; Types I and II are flammable, Types III and IV are nonflammable; and each has two classes, A, low viscosity and B, high viscosity. These are performance specifications and include the conventional paint strippers. Many paint strippers are available for the complete immersion of painted surfaces, but these are generally specialty items.

Once the strippers have performed the desired softening of the existing coating system, they are frequently

**TABLE 7**
**REFERENCE PHOTOGRAPHS IN SSPC-VIS 4 (I)**

| Initial Condition | Degree of Cleaning SSPC-SP 12 | Flash Rusting | | | |
|---|---|---|---|---|---|
| | | None | Light | Medium | Heavy |
| Rust Grade C | WJ-2 | C VIS WJ-2 | C VIS WJ-2 L | C VIS WJ-2 M | C VIS WJ-2 H |
| | WJ-3 | C VIS WJ-3 | C VIS WJ-3 L | C VIS WJ-3 M | C VIS WJ-3 H |
| Rust Grade D | WJ-2 | D VIS WJ-2 | D VIS WJ-2 L | D VIS WJ-2 M | D VIS WJ-2 H |
| | WJ-3 | D VIS WJ-3 | D VIS WJ-3 L | D VIS WJ-3 M | D VIS WJ-3 H |

WJ-2 - Almost clean to the bare substrate; very thorough cleaning; randomly dispersed visible stains of previously existing rust, paint, and foreign matter is allowed on only 5% of the surface

WJ-3 - Thorough cleaning; randomly dispersed visible stains of previously existing rust, paint, and foreign matter is allowed on only one-third of the surface

Provided by : www.spic.ir Licensee: NISOC Library

removed by a scraper. Water cleaning or ice blasting methods increase the volume of waste due to the addition of the water. Even for the removal of non-lead containing coatings, the resulting waste stream may be classified as hazardous due to either the caustic or the solvent component. Information on chemical stripping can be found in the technology update SSPC-TU 6, "Chemical Stripping of Organic Coatings from Steel Structures."

**9.2 SODIUM BICARBONATE BLASTING:** A relatively new, low dusting method of blast cleaning uses a slurry of water and sodium bicarbonate, a water soluble non-reactive salt, to remove paint from a surface. The portable unit can be wheeled from one location to another. Once in place, the system requires a source of compressed air (typically 600-700 kPa [85-100 psi] at the nozzle), clean water, and drainage. In most cases, special ventilation or dust collection is unnecessary. The operator can vary the angle of attack, standoff, and dwell time to strip layer by layer or all at once.

This blast media is a formulation of sodium bicarbonate and is free from silica dusts and toxic fumes. The media is claimed to be effective in:

- removing surface rust from screws and other metal parts without imbedding itself into the material being stripped
- removing coatings down to the metal or one layer at a time
- controlling layer removal, allowing for an extra measure of safety when used on galvanized or other specialty protected metals
- removing grease, oil, paint, and dirt from flat or contoured surfaces, cooling towers, motor parts, and hard-to-reach equipment parts.

This system was developed for removal of aircraft coatings and similar materials from surfaces which do not require "profiling". It also reduces dusting.

For blasting alone, productivity depends on the coating being removed and the degree of cleaning. Removal rates can be as high as 11 $m^2$/h (120 $ft^2$/h) for removal of thin deteriorated films. Removal of deteriorated thicker films may be much slower, on the order of 2 to 5 $m^2$/h (20 to 50 $ft^2$/h). Intact films may not be dislodged using sodium bicarbonate blasting.

**9.3 SPONGE JETTING:** Another low dusting method of cleaning, sponge jetting, involves the use of specialized blasting equipment that propels a manufactured urethane sponge against the surface to be cleaned. The sponge particles are approximately 3 to 6 mm (1/8 to 1/4 inch) in diameter and are available in a mild grade for degreasing and aggressive grades for paint or mill scale removal. The aggressive grades have the sponge formed around an abrasive. Abrasives include staurolite, garnet, and steel grit.

The productivity is lower than traditional abrasive blast cleaning (30-50% of the productivity), but typically will be higher than power tool cleaning to bare metal and vacuum blast cleaning. White metal quality of preparation is possible and a surface profile of approximately 50 micrometers (2 mils) can be achieved. The dust generated is low because the cells of the sponge help to suppress the dust, and the paint tends to be dislodged in larger chips rather than being pulverized, as is the case with traditional abrasive blast cleaning.

**9.4 CARBON DIOXIDE (DRY ICE) BLASTING:** In this dust free method, liquid carbon dioxide is formed into pellets of dry ice using specialized equipment. The $CO_2$ pellets are approximately the size of rice. The pellets are conveyed through a blast hose using compressed air in a manner similar to open abrasive blast cleaning. The pellets exit through a specialized nozzle assembly.

An advantage of $CO_2$ blasting is a reduction in the volume of debris created as the abrasive sublimes upon use. As a result, the waste involves only the paint being removed. Carbon dioxide is also non-conductive and will not create a spark, and therefore can be considered for use in areas where any sparking is unacceptable.

Disadvantages are that the abrasive does not appear to be hard enough to productively remove heavy coatings, rust, or mill scale. More than just stains of old primer will remain on the surface. Tight coatings are difficult to remove without frosting the surface. The equipment is also expensive.

**9.5 ELECTROCHEMICAL STRIPPING:** A very recent method of paint removal is electrochemical stripping. By applying cathodic current to a painted metal substrate, disbonding of the coating is achieved. The benign electrolyte is contained in a liquid-absorbent material to which a counter electrode is attached. This combination, often combined with a liner, is applied to the painted metal surface, with magnets in the case of steel. If the paint is intact it must be scored to initiate current flow. After electrochemical treatment for 0.5 to 2 hours at 8 to 10 volts, the pads are removed and paint fragments are recovered. No particles become airborne making this method attractive for lead paint removal.

Banks of conducting pads may cover an area up to 14 $m^2$ (150 $ft^2$) and can be run simultaneously. This method was developed particularly for application on highway structures to remove lead based alkyd-type coatings, but it may be employed for paint removal on other objects.

## 10. Film Thickness

It is essential that ample coating be applied after blast

Provided by : www.spic.ir Licensee: NISOC Library

cleaning to adequately cover and protect the peaks of the surface profile. The method of measuring dry film thickness (DFT) described in SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages," takes into account the effect of surface profile so that the measured DFT is approximately the thickness of the coating over the peaks. Thus, the depth of the surface profile should be considered in determining the amount of coating to be applied. For example, if a 50 micrometer (two mil) DFT is desired, it will require a larger volume of paint to fill the valleys in a 75 micrometer (three mil) profile than to fill the valleys in a 25 micrometer (one mil) profile and still have 50 micrometers (two mils) over the peaks. Because of the existence of rogue peaks, a greater coating thickness may need to be specified when coating deeper profiles.

## 11. Visual Standards

Note that visual standards, when used in conjunction with SSPC specifications, give only an approximation of the final surface condition, because the visual standards are based on one specific set of steel conditions and cleaning operations. These conditions will not be identical to the conditions faced on other projects. 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 suggested, however, that the visual standards be specified in the procurement document. Although they will not precisely match the appearance of the steel on every project, they are a valuable aid in establishing the general appearance described by the surface preparation specifications, and are especially useful in depicting the relative differences between the various grades. Even when visual standards are included in the procurement document, however, it must be recognized that the written standards prevail.

SSPC has visual standards for degrees of blast cleaning (SSPC-VIS 1), for the amount of rust on a painted surface (SSPC-VIS 2), for hand and power tool cleaning (SSPC-VIS 3), and for water jetting (SSPC-VIS 4). SSPC committees are currently preparing a visual standard for wet abrasive blasting. Other associations, such as ISO, as well as individual companies, have visual standards. The following sections summarize the SSPC visual standards.

**11.1 SSPC-VIS 1-89,"VISUAL STANDARD FOR ABRASIVE BLAST CLEANED STEEL":** SSPC-VIS 1-89 provides standard reference photographs for four rust grades (preblast conditions) and four degrees of blast cleaning thoroughness when using silica sand as the abrasive. SSPC-SP 5, 6, 7, and 10 are depicted over each initial condition. SSPC-VIS 1-89 is a separate publication; however, a written "Guide to SSPC-VIS 1-89" is included in this volume. The appendix of SSPC-VIS 1-89 includes supplementary photographs depicting the appearance of white metal surfaces prepared from alternative non-metallic and metallic abrasives.

**11.2 SSPC-VIS 2, "STANDARD METHOD OF EVALUATING DEGREE OF RUSTING ON PAINTED STEEL SURFACES":** This standard defines a rust grade scale which goes from 10 (no rust) to 0 (totally rusted). The 2000 edition of SSPC-VIS 2 defines three rust distributions:

- General Rust – consisting of various size rust spots randomly scattered over the surface
- Spot Rust – where the rusting is concentrated in a few large spots
- Pinpoint Rust – where each rust spot is very small and scattered across the surface.

This visual standard consists of 27 color photographs depicting rust grades 1 to 9 for each rust distribution. The photographs were computer enhanced to show the exact percentage of rust defined in the written standard. For each color photograph, there is a corresponding black and white image showing only the rusted areas. The previous edition of SSPC-VIS 2 had been jointly adopted by the American Society of Testing and Materials as ASTM D 610. The set of 27 color photographs that show rust staining and represent a more realistic picture of the painted surface is available from SSPC as a separate document. The written description and the black and white images are contained in this volume.

**11.3 SSPC-VIS 3, "VISUAL STANDARD FOR POWER- AND HAND-TOOL CLEANED STEEL":** This standard provides color photographs for the various grades of hand and power tool cleaning (SSPC-SP 2, 3, and 11) for various initial conditions of the steel. Seven initial conditions are depicted (four rust grades and three painted surfaces). While a guide to the standard is included in this volume, the photographs are only available as a separate supplement.

Written specifications are the primary means to determine conformance with cleaning requirements; photographs should not be used as a substitute for the written specifications.

**11.4 SSPC-VIS 4/NACE No. 7, "INTERIM GUIDE AND VISUAL REFERENCE PHOTOGRAPHS FOR STEEL CLEANED BY WATER JETTING":** This guide depicts two initial rust grade conditions cleaned to two degrees of water jetting cleanliness (SSPC-SP 12 conditions WJ-2 and WJ-3), each with three levels of flash rusting after cleaning. Table 7 gives the matrix identifying each picture.

**11.5 ISO VISUAL STANDARDS:** The International Organization for Standardization (ISO) in conjunction with Swedish Standards Institution (SIS) has issued a booklet of

Provided by : www.spic.ir Licensee: NISOC Library

photographs (ISO 8501-1:1988/SIS SS 05 59 00) depicting the appearance of surfaces prepared by hand and power tool cleaning, abrasive blast cleaning (four degrees) and flame cleaning. The methods of cleaning are depicted over various rust grades of unpainted steel. ISO 8501-2 depicts a similar set of surfaces where the substrate was previously painted steel.

**11.6 OTHER PHOTOGRAPHIC STANDARDS:** 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 illustrate the appearance of painted, unpainted, welded, and flame-cut steel before and after various degrees of damage or weathering.

British standard BS 7079 Part A1 is equivalent to ISO 8501-1 (unpainted steel) and BS 7079 Part A2 is equivalent to ISO 8501-2 (previously painted steel).

NACE International had previously developed visual aids for evaluating the degree of cleanliness of blast cleaned steel (TM-01-70 and TM-01-75), but they were withdrawn in 1995. Visual standard NACE No. 7 is jointly issued as SSPC-VIS 4 described above.

**11.7 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 prepare 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 dimensions of the reference steel panels are approximately 15 x 15 x 0.5 cm (6 x 6 x 3/16 inch) minimum. The blast cleaned panels should be completely protected from corrosion and contamination, and maintained as visual reference standards for the duration of the project. As an alternative to test panels, portions of the structure being prepared can be used.

## 12. Other SSPC Surface Preparation Documents in This Volume

**12.1 SSPC-TR 1/NACE 6G194, "JOINT TECHNOLOGY REPORT ON THERMAL PRECLEANING":** Thermal precleaning is used in conjunction with other surface preparation methods, such as abrasive blast cleaning, to remove soluble salts from the pits of heavily corroded steel. The oil and gas industry as well as the rail car industry use thermal precleaning extensively. This report describes the parameters used for dry heat and wet heat. It also lists methods for verifying the surface cleanliness.

**12.2 SSPC-TR 2/NACE 6G198, "JOINT TECHNICAL REPORT ON WET ABRASIVE BLAST CLEANING":** This document covers procedures, equipment, and materials involved in a variety of air/water/abrasive, water/abrasive, and water-pressurized abrasive blast cleaning systems. Various types of wet blast systems are described and compared. SSPC-TR 2 discusses selection of abrasives, water delivery systems, inhibitors, and equipment operation and maintenance. (See Section 7.2.)

**12.3 SSPC-TU 2/NACE 6G197, "INFORMATIONAL REPORT AND TECHNOLOGY UPDATE: DESIGN, INSTALLATION, AND MAINTENANCE OF COATING SYSTEMS FOR CONCRETE USED IN SECONDARY CONTAINMENT":** This state-of-the-art report covers the design, installation, and maintenance of polymeric coating systems that are applied and directly bonded to concrete is secondary containment applications. This report is intended to inform manufacturers, specifiers, applicators, and facility owners who are required to contain chemicals and/or protect concrete in these applications.

A chemical resistant coating is often applied to concrete to extend the service life of the secondary containment structure and properly contain the chemicals. This report focuses on those aspects of the design, materials, and procedures that are specific to coating for concrete in secondary containment applications, making reference to other publications when appropriate. While there are numerous successful commercial products and designs for containment of chemicals, this report focuses on concrete structures that are coated with thermoset polymer coating systems. Other potentially effective containment systems, such as acid-resistant brick and thermoplastic liners, are not described in this report.

**12.4 SSPC-TU 4, "FIELD METHODS FOR RETRIEVAL AND ANALYSIS OF SOLUBLE SALTS ON SUBSTRATES":** This technology update describes methods for estimating the amount of soluble salt on a surface. Two types of retrieval methods, the cell method and the swabbing or washing method, are applicable to field retrieval. The "total" extraction method involves immersion of the surface in boiling water and, hence, is useful only in a laboratory.

SSPC-TU 4 gives detailed procedures for obtaining a liquid sample and for analyzing it to determine the level of soluble salt. Test kits are available to simplify the extraction and analysis. The SSPC standard on water jetting, SSPC-SP 12, defines three levels of soluble salt contamination or non-visible surface cleanliness.

**12.5 SSPC-TU 6, "CHEMICAL STRIPPING OF ORGANIC COATINGS FROM STEEL STRUCTURES":** This document defines chemical strippers and discusses their

Provided by : www.spic.ir Licensee: NISOC Library

use for removing conventional organic coatings from steel structures. Chemical stripping involves application of a chemical to existing paint, allowing it to dwell for a period of time to attack the organic binder, removing bulk paint/stripper residues, and properly cleaning the steel substrate prior to repainting. This technology update describes methods used to identify the type of stripper that will work most effectively, and typical application and removal options. It also presents containment and disposal options for stripper wastes.

## 13. Non-SSPC Cleaning Specifications

The recommendations, specifications, and guides of a number of other associations reference the SSPC 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.

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 US Army 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.

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 International Organization for Standardization (ISO) has included written definitions and photographs depicting the appearance of uncoated steel surfaces cleaned by flame cleaning (ISO 8501-1: 1988). This book also includes photographs for uncoated steel surfaces cleaned by hand and power tools and by abrasive blasting. A parallel standard ISO 8501-2 depicts degrees of cleaning over previously painted surfaces.

The British Standards Institution standard BS 7079:Parts A1 and A2, "Preparation of Steel Substrates Before Application of Paints and Related Products" is essentially equivalent to ISO 8501-1 and ISO 8501-2.

## 14. Surface Preparation of Concrete for Coating

**14.1 INDUSTRY STANDARDS:** There are several relatively new SSPC publications for surface preparation and coating of concrete included in this volume:

- SSPC-SP 13/NACE NO. 6, "Surface Preparation of Concrete"
- SSPC-TU 2/NACE 6G197, "Informational Report and Technology Update: Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment"
- SSPC-Guide 11, "Guide for Coating Concrete."

The International Concrete Repair Institute (ICRI) has defined nine concrete profiles, thirteen methods of achieving them, and five different coating thickness ranges. ICRI has also developed a set of rubber replica specimens for the nine different profiles. These rubber replicas and the accompanying document, ICRI Guideline No. 03732, "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays," are available from SSPC. NACE and ASTM have also issued standards on surface preparation, repair, coating, and inspection of concrete. These are referenced in the SSPC documents listed above.

**14.2 METHODS OF CLEANING CONCRETE:** Concrete may be cleaned by many of the same methods used to clean steel for painting. However, care must be exercised so as not to damage the concrete surface. Concrete may be cleaned with detergent/power washing, alkaline or steam cleaning, chemical cleaning, abrasive blasting, high-pressure water cleaning, or mechanical cleaning with pneumatic tools, scarifiers, and scabblers. Efflorescence must be removed from cementitious surfaces by dry wire brushing or other mechanical means before any washing occurs. Water will merely dissolve the efflorescence and force it into the concrete.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# GUIDE TO SSPC-VIS 1-89

## Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs)

### 1. Scope

This guide describes the use of standard reference photographs depicting the appearance of previously unpainted hot-rolled carbon steel prior to and after abrasive blast cleaning. These photographs are intended to be used to supplement the written SSPC blast cleaning surface preparation specifications. As the written specifications are the primary means to determine conformance with blast cleaning requirements, the photographs shall not be used as a substitute for these specifications. (See Note 7.1.)

### 2. Description

The standard consists of a series of 1:1 (actual size) color photographs which represent various conditions of unpainted steel surfaces prior to and after surface preparation by abrasive blast cleaning.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.3 and form a part of this guide.

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

**3.3 SSPC/NACE JOINT STANDARDS:**

| | |
|---|---|
| **SSPC-SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SSPC-SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SSPC-SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SSPC-SP 10/NACE No. 2** | Near-White Metal Blast Cleaning |

### 4. Conditions Depicted

**4.1** The standard (SSPC-VIS 1-89) illustrates four initial rust grades before surface preparation and covers the range from intact mill scale to rusted and pitted steel. These rust grades are:

| | |
|---|---|
| Rust Grade A | Steel surface completely covered with adherent mill scale; little or no rust visible. |
| Rust Grade B | Steel surface covered with both mill scale and rust. |
| Rust Grade C | Steel surface completely covered with rust; little or no pitting visible. |
| Rust Grade D | Steel surface completely covered with rust; pitting visible. |

**4.2** The standard illustrates surfaces prepared by abrasive blast cleaning using sand. The various degrees of cleaning represented are:

| | |
|---|---|
| SSPC-SP 5 | White Metal Blast Cleaning |
| SSPC-SP 6 | Commercial Blast Cleaning |
| SSPC-SP 7 | Brush-Off Blast Cleaning |
| SSPC-SP 10 | Near-White Metal Blast Cleaning |

(The full titles of the SSPC/NACE joint surface preparation standards are provided in Section 3.3)

**4.3** Photographs illustrative of some variations in color, texture, and general appearance that can result from the choice of abrasive are provided in an Appendix to the standard (see also Note 7.2). The Appendix is provided for information only and does not constitute a part of the standard. The Appendix photographs represent adherent mill scale (Rust Grade A) blast cleaned to white metal (SSPC-SP 5) by various nonmetallic and metallic abrasives. The variations in appearance are depicted only for white metal; however, these same variations must be considered when assessing steel prepared to other degrees of cleaning.

### 5. Procedures

**5.1** Select the photograph of the rust grade (A, B, C, or D) that most closely represents the appearance of the steel to be cleaned. The steel to be cleaned may contain more than one of the initial rust grades.

**5.2** Determine the degree of cleaning that is specified (SSPC-SP 7, SSPC-SP 6, SSPC-SP 10, or SSPC-SP 5).

Provided by : www.spic.ir Licensee: NISOC Library

The full titles of the SSPC/NACE joint surface preparation standards are provided in Section 3.3.

**5.3** Use Table 1 to determine which photograph depicts the finished surface. For example, if the initial rust grade is "C" and commercial blast cleaning (SSPC-SP 6) is specified, use photograph C SP 6.

**5.4** Compare the prepared surface with the photograph selected in Section 5.3 to evaluate the degree of cleaning.

**5.5** This visual standard shall be used only in conjunction with the written SSPC/NACE joint surface preparation specifications, as it is based upon appearance only and does not address other factors necessary for compliance with the written specification. Steel surfaces show variations in texture, shade, color, tone, pitting, flaking, mill scale, etc., which should be considered when making a comparison with the reference photographs.

## 6. Disclaimer

While every precaution is taken to insure that all information furnished in SSPC guides and standards is as accurate, complete, and useful as possible, SSPC cannot assume any responsibility nor incur any obligation resulting from the use of any materials or methods specified therein, or of the guides or standards themselves.

## 7. Notes*

**7.1** Although prepared from unpainted steel, the photographs may also be suitable for depicting the appearance of painted steel after blast cleaning.

**7.2** The photographs of non-metallic abrasives in the Appendix illustrate the range of appearance produced by non-metallic abrasives as a class. Among the abrasives included in this class are silica sand, olivine sand, garnet, flint shot, copper slag, coal slag, and nickel slag. The abrasive used for each photograph is not specifically identified because wide variations in appearance were observed among the abrasives within a given generic class (e.g., copper slag).

A similar set of photographs illustrates the range of appearance produced by metallic abrasives as a class, which includes steel shot, steel grit, and combinations and modifications of these two abrasive media.

**7.3** SSPC-VIS 1-89 is comprised of photographs prepared by SSPC to comply with the written SSPC abrasive blast cleaning standards. The previous VIS 1, prepared in conjunction with the Swedish Standards Institution (SIS), has been revised by the International Organization for Standardization (ISO) and is available from SIS or SSPC as ISO Standard 8501-1/SIS SS 05 59 00 (1988).

*Notes are not a requirement of this specification.

**TABLE 1**

| Degree of Cleaning | A<br>100% Adherent<br>Mill Scale | B<br>Mill Scale<br>and Rust | C<br>100%<br>Rust | D<br>100% Rust<br>With Pits |
|---|---|---|---|---|
| Brush-Off Blast Cleaning (SSPC-SP 7) | [1] | B SP 7 | C SP 7 | D SP 7 |
| Commercial Blast Cleaning (SSPC-SP 6) | [2] | B SP 6 | C SP 6 | D SP 6 |
| Near-White Blast Cleaning (SSPC-SP 10) | A SP 10 | B SP 10 | C SP 10 | D SP 10 |
| White Metal Blast Cleaning (SSPC-SP 5) | A SP 5[3] | B SP 5 | C SP 5 | D SP 5 |

[1] Standard photograph not provided due to wide variations in appearance possible when brush-off blast cleaning adherent mill scale.

[2] No photograph available because this condition cannot normally be attained when removing adherent mill scale.

[3] The photographs contained in the Appendix depict the appearance of surfaces blast cleaned with alternate abrasives (see Note 7.2).
- Alternate non-metallic abrasives: A SP 5-N1, A SP 5-N2, A SP 5-N3
- Alternate metallic abrasives: A SP 5-M1, A SP 5-M2, A SP 5-M3

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# GUIDE TO VISUAL STANDARD NO. 2

## Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces

### 1. Scope

**1.1** This standard provides a method to evaluate the degree of rusting on painted steel (or iron) surfaces. The reference color photographs and corresponding black and white images, which depict the percentage of rusting given in the written specification, form part of the standard. In the event of a dispute, the written definitions prevail.

**1.2** This standard is particularly useful for evaluating rust on test panels or on localized areas of structures. (See Section 7.1.)

### 2. Description

**2.1** This standard quantifies the degree of rusting on painted steel surfaces with a zero to ten scale based on the percentage of visible rust present on the surface. Visible rust includes rust blisters and undercutting of the coating. (See Section 7.3.)

**2.2** The distribution of the rust is classified as spot rust, general rust, or pinpoint rust.

**2.3** Standard reference photographs depict the appearance of painted steel surfaces with the appropriate percentage of rusting for various distributions of the rust. The rusting depicted in the photographs is not accompanied by blistering, but the photographs show staining associated with the rust. Black and white images highlight only those areas that are rusted. Both the color photographs and the black and white images enable the evaluator to assign an accurate rust grade.

### 3. Reference Standards

**3.1** The standards listed here are referenced only in the Notes, which are not requirements of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS**:

| | |
|---|---|
| **VIS 1** | Visual Standard for Abrasive Blast Cleaned Steel |
| **VIS 3** | Visual Standard For Power- and Hand-Tool Cleaned Steel |
| **VIS 4/NACE No. 7** | Interim Guide and Visual Reference Photographs for Steel Cleaned by Water Jetting |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| D 610 | Standard Method of Evaluationg Degree of Rusting on Painted Steel Surfaces |

**3.6 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO):**

| | |
|---|---|
| **4628-3** | Paints and varnishes – Evaluation of degradation of paint coatings – Designation of intensity, quantity and size of common types of defect – Part 3: Designation of degree of rusting |

### 4. Rust Grade Scale

**4.1** The painted steel surface to be evaluated for degree of rusting shall be assigned a rust grade based on the percentage of visible rust on the surface. The rust grade scale is defined in Table 1. The scale and description shown in Table 1 shall be used in conjunction with the photographic reference standards. (See Notes 9.1, 9.2 and 9.3.)

### 5. Rust Distribution

**5.1 SPOT RUSTING:** Spot rusting occurs when the bulk of the rusting is concentrated in a few localized areas of the painted surface. The reference photographs depicting this type of rusting are labeled 9-S through 1-S. (See Note 9.4.)

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1- SCALE AND DESCRIPTION OF RUST GRADES**

| Rust Grade | Percent of Surface Rusted | Photographic Standard | | |
|---|---|---|---|---|
| | | Spot | General | Pinpoint |
| 10 | Less than or equal to 0.01 percent | NONE | | |
| 9 | Greater than 0.01 percent to 0.03 percent | 9-S | 9-G | 9-P |
| 8 | Greater than 0.03 percent to 0.1 percent | 8-S | 8-G | 8-P |
| 7 | Greater than 0.1 to 0.3 percent | 7-S | 7-G | 7-P |
| 6 | Greater than 0.3 percent to 1 percent | 6-S | 6-G | 6-P |
| 5 | Greater than 1 percent to 3 percent | 5-S | 5-G | 5-P |
| 4 | Greater than 3 percent to 10 percent | 4-S | 4-G | 4-P |
| 3 | Greater than 10 percent to 16 percent | 3-S | 3-G | 3-P |
| 2 | Greater than 16 percent to 33 percent | 2-S | 2-G | 2-P |
| 1 | Greater than 33 percent to 50 percent | 1-S | 1-G | 1-P |
| 0 | Greater than 50 percent | NONE | | |

**5.2 GENERAL RUSTING:** General rusting occurs when various size rust spots are randomly distributed across the surface. The reference photographs depicting this type of rusting are labeled 9-G through 1-G. (See Note 9.4.)

**5.3 PINPOINT RUSTING:** Pinpoint rusting occurs when the rust is distributed across the surface as very small individual specks of rust. The reference photographs depicting this type of rusting are labeled 9-P through 1-P. (See Note 9.4.)

**5.4 OTHER RUSTING:** An actual rusting surface may be a hybrid combination of the types of rust distribution depicted in the reference photographs. In this case, combinations of the photographs and rust grades may be needed to classify the surface.

## 6. Conditions Depicted

**6.1** The standard contains 27 color photographs of painted surfaces and the corresponding black and white rust images illustrating the maximum percentage of rusting allowed for each rust grade from rust grade 9 to rust grade 1 for three different rust distributions. Each color photograph and black and white image are labeled with the corresponding numerical rust grade followed by a letter indicating the type of rust distribution. The percentage of visible rust is also shown with each reference photograph. No photographs are used to depict rust grade 10 (less than 0.01 percent rust) or to depict rust grade 0 (over 50 percent rust). (See Note 9.5.)

## 7. Procedures

**7.1 SELECT AREA:** Select the area which is to be evaluated for degree of rusting. This area may be as small as a test panel or as large as the hull of a ship. For complex structures, each member may be evaluated as a whole, or different sections may be evaluated separately (e.g., top of flange, web of a beam, or edges).

**7.2 DETERMINE RUST DISTRIBUTION:** Determine the rust distribution (spot, general, or pinpoint) that most closely matches the selected area. Compare the selected area with the corresponding color photograph or black and white image. Determine the percentage of rust on the surface by visual comparison with the reference photographs, by electronic scanning techniques, or other methods agreed upon by the contracting parties.

**7.3 DETERMINE RUST GRADE:** The rust grade is determined by the percentage of visible rust on the surface as defined in Table 1. If rust buildup is evident under the coating, as in a rust blister or as rust undercutting, then that rusted area shall be included in the determination of the rust grade.

**7.3.1** A rust blister is defined as a spot on a painted surface where the coating is intact but raised from the surface by the expansion of rust. The rust is not visible, but lies beneath the coating. A rust blister is not the same as a fluid-filled blister, which is typically caused by osmotic pressure or solvent entrapment. The volume of rust (if present) in a fluid-filled blister is a small percentage of the volume of the blister, whereas rust occupies most of the volume of a rust blister. A fluid-filled blister may collapse, but a rust blister will not collapse. (See Notes 9.6 and 9.7) Fluid-filled blisters should not be included in the determination of the rust grade.

**7.3.2** If rust blisters are present, the rust grade shall be determined considering the rust blisters as visible rust. This rating must be recorded in such a manner that it is clear to the contracting parties that rust blisters were present and that they were considered as visible rust when assigning a rust grade.

**7.3.3** Rust undercutting at a damaged area, at a broken blister, or at a place where the painted surface meets a

Provided by : www.spic.ir Licensee: NISOC Library

rusted area, shall be considered as visible rust in the determination of the rust grade. A dull putty knife may be used to remove loose coating, thereby exposing the rusted areas.

**7.4 OTHER CONSIDERATIONS:** Care must be exercised when determining the percentage of rust on the surface.

**7.4.1** Some finishes are stained by rust. This staining shall not be considered as rust.

**7.4.2** Accumulated dirt or other material may make accurate determination of the degree of rusting difficult. This dirt shall not be considered as rust.

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

**7.4.5** In evaluating surfaces, consideration shall be given to the color of the finish coating. A light surface that contrasts with the rust may appear to have a lower rust grade than a similarly rusted surface with a color that blends with the rust.

**7.5 REPORTING:** Report the area or item evaluated, the type or types of rust distribution, the presence of rust blisters (if applicable), and the rust grade.

## 8. Disclaimer

While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

## 9. Notes

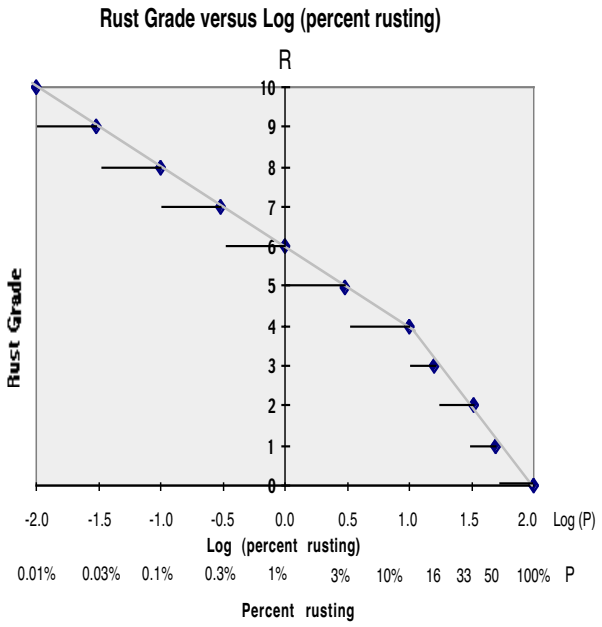
Notes are not a requirement of this standard.

**9.1** The rust grade scale is designed for use in distinguishing relatively large changes in the percentage of rust on the surface. For example, this standard is not intended to distinguish between 3.5 and 3.6% rust, even if electronic scanning equipment is used. For low rust levels, the amount of rust must triple before falling to the next rust grade. The standard photographs and the black and white images aid the inspector in distinguishing between adjacent rust grades.

**9.2** The numerical rust grade is a logarithmic function of the percent area of rust so that slight amounts of initial rusting have the greatest effect on lowering the rust grade. The graph of rust grade versus log (percent rust) is a straight line from rust grade 10 to rust grade 4. The slope of the curve was changed between 10 percent of the area rusted to 100 percent rusted to permit inclusion of complete rusting on the 0 to 10 rust grade scale. The relationship between the rust grade, R, and the maximum percent of rusting, P, is approximated closely by the equations:

$R = 6 - 2 \log (P)$ for rusting from 0.01% to 10% (rust grades 10 to 4), and

$R = 8 - 4 \log (P)$ for rusting from 10% to 100% (rust grades 4 to 0).




**9.3** Table 2 compares the rust grades defined by ISO 4628-3 with the European rust scale and with the rust grades defined by this standard.

**Table 2**
**Approximate Correlation Among SSPC/ASTM, ISO, and European Rust Grade Scales**

| SSPC-VIS 2/ASTM D 610 | | ISO* | | European Rust Grade** |
|---|---|---|---|---|
| Area Rusted, % | Rust Grade | Area Rusted, % | Rust Grade | |
| <0.01 | 10 | 0 | Ri 0 | Re 0 |
| 0.03 to 0.1 | 8 | 0.05 | Ri 1 | Re 1 |
| 0.3 to 1 | 6 | 0.5 | Ri 2 | Re 2 |
| 0.3 to 1 | 6 | 1 | Ri 3 | Re 3 |
| 3 to 10 | 4 | 8 | Ri 4 | Re 5 |
| 33 to 50 | 1 | 40/50 | Ri 5 | Re 7 |

* ISO 4628-3

** "European scale of degree of rusting for anticorrosive paints" published by the Comité Européen des associations de fabricants de peintures et d'éncres d'imprimerie in 1964.

Provided by : www.spic.ir Licensee: NISOC Library

**9.4** Spot rusting has been associated with barrier coatings such as epoxy or urethane coatings. General rusting has been associated with oil, alkyd, and latex paints. Pinpoint rusting has been associated with untopcoated zinc-rich coatings, thin inadequately applied coatings, or as flash rusting on waterborne primers.

**9.5** In addition to this standard, SSPC has visual standards for blast cleaned steel (SSPC-VIS 1), for hand and power tool cleaned steel (SSPC-VIS 3), and for steel cleaned by water jetting (SSPC-VIS 4).

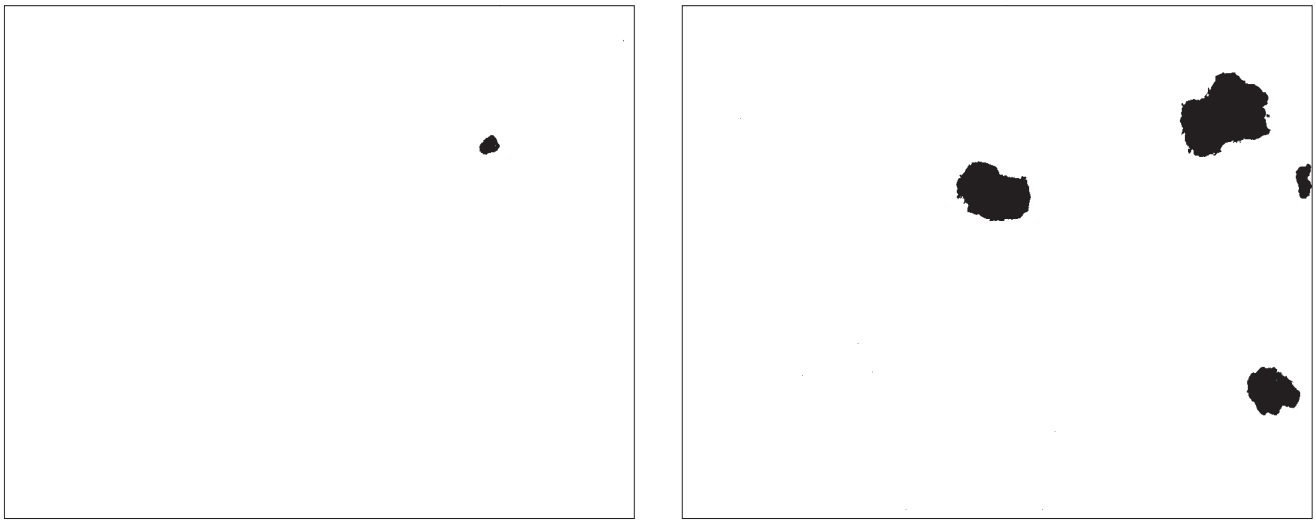
**9.6** The nature of a blister can usually be determined visually, by touching it, or by breaking it. If the blister has collapsed, it was a fluid filled blister. If liquid flows out and the blister then collapses, it was a fluid filled blister. The hard build-up of rust beneath the paint can usually be felt by touching the blister, thereby identifying it as a rust blister. If these methods are inconclusive, cutting the blister with a knife or carefully scraping it off with a dull putty knife will make it easy to determine the nature of the blister.

**9.7** Fluid filled blisters should not be considered in determining the rust grade. A fluid filled blister may form in a relatively short time and then remain intact for years, especially in immersion environments. A fluid filled blister may form between coats while the steel substrate is still protected.

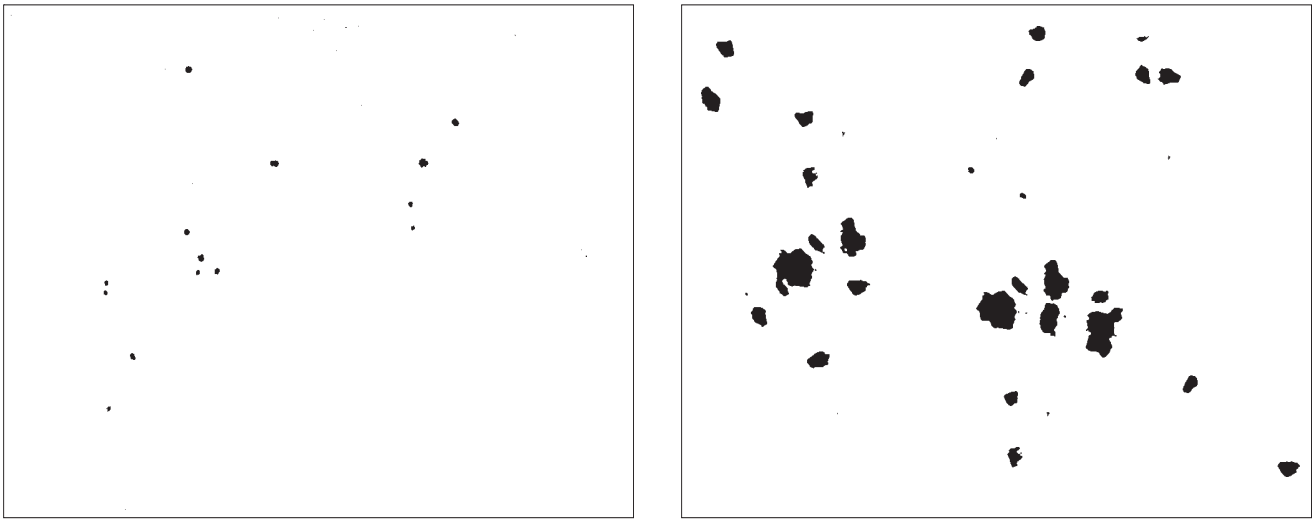
Provided by : www.spic.ir Licensee: NISOC Library

# Sample Black and White Images from SSPC-VIS 2

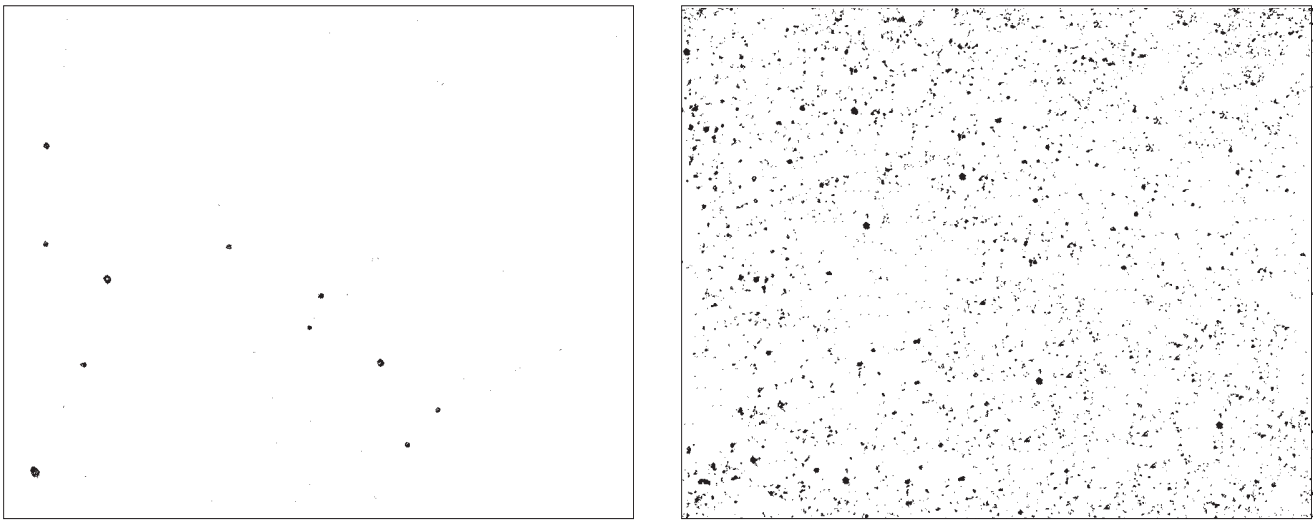
**Rust Grade 8, 0.01% Rusted** | **Rust Grade 5, 3% Rusted**



**Spot Distribution**



**General Distribution**



**Pinpoint Distribution**



Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# GUIDE TO SSPC-VIS 3

## Visual Standard for Power- and Hand-Tool Cleaned Steel (Standard Reference Photographs)

### 1. Scope

This guide describes the use of standard reference photographs depicting the appearance of unpainted, painted, and welded hot-rolled carbon steel prior to and after power and hand tool cleaning. These photographs are intended to be used to supplement the written SSPC power and hand tool surface preparation specifications. As the written specifications are the primary means to determine conformance with cleaning requirements, the photographs shall not be used as a substitute for the written specifications.

### 2. Description

This standard consists of color photographs which represent various conditions of unpainted, painted, and welded steel surfaces prior to and after power- and hand-tool cleaning.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.3 and form a part of this guide.

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

**3.3 SSPC STANDARDS:**

| | |
|---|---|
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 11** | Power Tool Cleaning to Bare Metal |

### 4. Conditions Depicted

**4.1 INITIAL CONDITIONS:** The standard (SSPC-VIS 3) illustrates seven initial conditions before surface preparation. (See Notes 7.1, 7.2 and 7.3.)

| | |
|---|---|
| Condition A | Steel surface completely covered with adherent mill scale; little or no rust visible (Rust Grade A). |
| Condition B | Steel surface covered with both mill scale and rust (Rust Grade B). |
| Condition C | Steel surface completely covered with rust; little or no pitting visible (Rust Grade C). |
| Condition D | Steel surface completely covered with rust; pitting visible (Rust Grade D). |
| Condition E | Previously painted steel surface; light-colored paint applied over blast-cleaned surface, paint mostly intact. |
| Condition F | Previously painted steel surface; zinc-rich paint applied over blast-cleaned steel, paint mostly intact. |
| Condition G | Painting system applied over mill scale bearing steel; system thoroughly weathered, thoroughly blistered, or thoroughly stained. |

**4.2 END CONDITION:** The standard illustrates surfaces prepared by several hand and power tools. The various degrees of cleaning and tools represented are:

| | |
|---|---|
| SSPC-SP 2 | Hand Tool Cleaning by hand wire brush (SP 2). |
| SSPC-SP 3 | Power Tool Cleaning by power wire brush (SP 3/PWB). |
| SSPC-SP 3 | Power Tool Cleaning by sanding disc (SP 3/SD). |
| SSPC-SP 3 | Power Tool Cleaning by needle guns (SP 3/NG). |
| SSPC-SP 11 | Power Tool Cleaning to Bare Metal by rotary flaps or needle guns (See Note 7.4). |
| SSPC-SP 11 | Power Tool Cleaning to Bare Metal by restoration (re-exposure) of previously existing profile by non-woven disks (See Note 7.5). |

### 5. Procedures

**5.1** Determine initial condition of steel as follows:

**5.1.1** If the steel has not been previously painted, proceed to 5.1.2 If it has been painted, proceed to 5.1.3.

Provided by : www.spic.ir Licensee: NISOC Library

**5.1.2** Select the photograph of the condition grade (A, B, C or D) that most closely represents the appearance of the unpainted steel to be cleaned. Steel to be cleaned may contain more than one of the initial conditions (rust grades).

**5.1.3** Select the photograph of the condition grade (E, F or G) that most closely represents the appearance of the previously painted steel to be cleaned. Steel to be cleaned may contain more than one of the initial conditions.

**5.2** Determine the condition and tools to be evaluated as follows:

**5.2.1** If hand tool cleaning (SSPC-SP 2) has been specified, use the designation SSPC-SP 2 (SP 2).

**5.2.2** If power tool cleaning (SSPC-SP 3) has been specified, determine which of the following tools were used: power wire brush (designated SP 3/PWB), sanding disk (designated SP 3/SD), or needle guns (designated SP 3/NG).

**5.2.3** If power tool cleaning to bare metal (SSPC-SP 11) has been specified, determine if the intent was to produce a profile (5.2.3.1) or to restore (re-expose) an existing profile (5.2.3.2). If this cannot be determined, go to 5.2.3.1.

**5.2.3.1** If no profile exists or the profile condition is unknown, use the designation SP 11. This condition can be produced by using either rotary flap peening assembly or 2 mm needle guns. (See Note 7.4.)

**5.2.3.2** If there is an existing profile to be restored (reexposed), use the designation SSPC-SP 11 (Non-Woven Disk to Restore [Re-Expose] Profile) or SSPC-SP 11/R. In this case SSPC-SP 11 will be achieved using non-woven disks. (See Note 7.5.)

**5.3** Select reference photographs as follows:

**5.3.1** Refer to Table 1 to determine which photograph depicts the finished surface.

**5.3.2** If SSPC-SP 3 has been specified, use the photograph which corresponds to the type of power tool used (e.g., for power wire brush use SP 3/PWB). If it cannot be determined which power tool was used, any of the three end conditions (i.e., SP 3/PWB, SP 3/SD, or SP 3/NG) is acceptable.

**5.4** Determine conformance with photographs as follows:

**5.4.1** Compare the prepared surface with the photographs selected in Section 5.3 to evaluate the degree of cleaning and its conformance with the standard (SSPC-VIS 3).

**5.4.2** The visual standard shall be used only in conjunc-

**TABLE 1**

| Initial Surface Condition | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| Initial Condition Description | 100% Adherent Mill Scale | Mill Scale & Rust | 100% Rust | 100% Rust With Pits | Light-Colored Paint Applied Over Blast Cleaned Steel | Zinc-RIch Paint Applied Over Blast Cleaned Steel | Painting System Applied Over Mill Scale (Note 3) |
| Weld Seam Present (Note 1) | Yes | Yes | Yes | Yes | No | Yes | No |
| Degree of Cleaning & Tool | | | | | | | |
| Hand Tool Cleaning (SSPC-SP 2/Wire Brush) | A SP2 | B SP2 | C SP2 | D SP2 | E SP2 | F SP2 | G SP2 |
| Power Tool Cleaning (SSPC-SP 3/Power Wire Brush) | A SP3/PWB | B SP3/PWB | C SP3/PWB | D SP3/PWB | E SP3/PWB | F SP3/PWB | G SP3/PWB |
| Power Tool Cleaning (SSPC-SP 3/Sanding Disc) | A SP3/SD | B SP3/SD | C SP3/SD | D SP3/SD | E SP3/SD | F SP3/SD | G SP3/SD |
| Power Tool Cleaning (SSPC-SP 3/Needle Gun) | A SP3/NG | B SP3/NG | C SP3/NG | D SP3/NG | E SP3/NG | F SP3/NG | G SP3/NG |
| Power Tool Cleaning to Bare Metal (SSPC-SP 11/Needle Gun or Rotary Flap Peen - Produce Profile) | A SP11 | B SP11 | C SP11 | D SP11 | E SP11 | F SP11 | G SP11 |
| Power Tool Cleaning to Bare Metal (SSPC-SP 11/Non-Woven Disk Restore [Re-Expose] Profile) | (Note 2) | (Note 2) | (Note 2) | (Note 2) | E SP11/R | F SP11/R | (Note 2) |

Note 1: No special treatment was performed on the welds prior to surface preparation.
Note 2: No photo provided - initial condition did not have original profile to be restored (re-exposed).
Note 3: Substrate consisted of 2-1/4 inch (57 mm) wide lacing bars.

Provided by : www.spic.ir Licensee: NISOC Library

tion with the written SSPC surface preparation specifications, as it is based upon appearance only and does not address other factors necessary for compliance with the written specification.

**5.4.3** Steel surfaces show variations in texture, shade, color, tone, pitting, flaking, mill scale, etc., which should be considered when making comparisons with the reference photographs.

## 6. Disclaimer

Every precaution is taken to ensure that all information furnished in SSPC guides and standards is as accurate, complete, and useful as possible. SSPC cannot assume any responsibility nor incur any obligation resulting from the use of any materials or methods specified therein, including guides and standards.

## 7. Notes*

**7.1** Conditions A, B, C, and D are "new construction" surface conditions, and are defined in Section 3.1 of the SSPC Surface Preparation Commentary.

**7.2** Conditions E, F, and G are "maintenance" surface conditions. Condition E and F represent surfaces having aged coatings originally applied over blast cleaned steel. Condition G represents surfaces having aged coatings originally applied over mill scale bearing steel. Although many surfaces encountered in practice may not closely correspond to conditions E, F, or G, careful extrapolation of the photographs can still aid in determining conformance with the cleaning requirements.

**7.3** Weld seams have been included with Conditions A, B, C, D, and F to depict the appearance of welds cleaned by power and hand tools prior to painting.

**7.4** In some instances it may be necessary to reduce the roughness and depth of profile using non-woven disks or other tools.

**7.5** In using this approach, one should make sure that the surface meets the SSPC-SP 11 requirement for a 1 mil (25 micrometer) minimum profile.

* Notes are not requirements of this specification.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# INTERIM GUIDE TO SSPC-VIS 4(I)/NACE NO. 7

## Visual Reference Photographs for Steel Cleaned by Water Jetting

### Disclaimer

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

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

CAUTIONARY NOTICE: This Guide is subject to periodic review and may be revised or withdrawn at any time without prior notice. This Interim Guide must be reaffirmed, revised, or reviewed no later than two years from the date of initial publication. The user is cautioned to obtain the latest edition. For information on this and other joint SSPC/NACE publications, contact either organization. The SSPC Publications Dept. may be reached at 40 24th Street, Pittsburgh, PA 15222-4656 (telephone +1 412-281-2331). The NACE International Membership Services Dept. may be reached at P.O. Box 218340, Houston, Texas 77218-8340 (telephone +1 281 228-6200).

### Foreword

This guide describes the use of the visual reference photographs depicting the appearance of mill scale-free, unpainted, rusted carbon steel prior to and after cleaning by water jetting (WJ). The steel surfaces had previously been blast cleaned to remove the mill scale and were then allowed to rust. Although prepared from unpainted steel, the photographs are also suitable for depicting the appearance of painted steel after water jetting.

NOTE: SSPC and NACE International Visual Reference Photographs are intended to supplement SSPC-SP 12/NACE No. 5. Due to the time required for consensus review, and the industry demand for immediate assistance in evaluating surfaces cleaned by water jetting, SSPC and NACE have issued this document as an interim status guide, using preexisting photographs which could not be adjusted or replaced. Therefore, these photographs and their descriptions do not exactly match the descriptions in SSPC-SP 12/NACE No. 5. The pictures and descriptions of flash rusting are included for information only and have not been established as standards. A new series of photographs is currently undergoing consensus review, which will result in the development of a set of photographs and text which will replace this interim guide. As the written standards are the primary means to determine conformance with cleaning requirements, the photographs should not be used as a substitute for these standards.

The guide is applicable to surfaces produced by a range of water jetting pressures. This guide can be used to clarify the acceptable level of flash rusting allowed prior to the application of protective coatings.

### 1. General

**1.1 DESCRIPTION:** The Visual Reference Photographs consist of a series of color photographs which represent various conditions of unpainted steel surfaces prior to and after surface preparation by high pressure or ultrahigh pressure water jetting as defined in SSPC-SP 12/NACE No. 5 (see Section 2.3).

**1.2 DEFINITIONS**

**1.2.1 High Pressure Water Jetting (HP WJ):** cleaning performed at pressures from 70 to 170 MPa (10,000 to 25,000 psi).

Provided by : www.spic.ir Licensee: NISOC Library

**1.2.2 Ultrahigh Pressure Water Jetting (UHP WJ):** Cleaning performed at pressures above 170 MPa (25,000 psi).

**1.2.3 Low and High Pressure Water Cleaning:** In addition to high pressure and ultrahigh pressure water jetting, SSPC-SP 12/NACE No. 5 defines two additional cleaning methods using water at lower pressure.

- **Low Pressure Water Cleaning** (LP WC) is cleaning performed at pressures less than 34 MPa (5,000 psi)
- **High Pressure Water Cleaning** (HP WC) is cleaning performed at pressures from 34 to 70 MPa (5,000 to 10,000 psi).

**1.2.4 Generic Terms:** The terms hydroblasting, hydrojetting, and water jetting describe the process in which pressurized water is directed through a nozzle to impact a surface. For purposes of this guide, hydroblasting, hydrojetting, and water jetting essentially mean the same thing. However, it is noted that the term hydroblasting is used generically to describe cleaning methods that range from low pressure water cleaning to ultrahigh pressure water jetting.

**1.3 Use of Guide:** This guide describes a procedure for determining the degree of surface cleanliness by water jetting. The guide further describes a procedure for determining the degree of flash rusting.

**1.3.1** The user of this guide must designate the degree of cleaning as WJ-3 ("Thorough Cleaning") or WJ-2 ("Very Thorough Cleaning"). (See Section 3.2.)

**1.3.2** The user of this guide must designate the maximum degree of flash rusting permissible as None (original condition), Light (L), Moderate (M), or Heavy (H) rusting. (See Section 3.3.)

## 2. Reference Standards

**2.1** The standards referenced in this guide are listed in Section 2.3 through 2.6 and form a part of this guide.

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

**2.3 SSPC/NACE INTERNATIONAL JOINT STANDARD:**

| | |
|---|---|
| **SSPC-SP 12/ NACE NO. 5** | Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh Pressure Water Jetting Prior to Recoating |

**2.4 SSPC VISUAL STANDARD:**

| | |
|---|---|
| **VIS 1-89** | Visual Standard for Abrasive Blast Cleaned Steel |

**2.5 INTERNATIONAL STANDARDS ORGANIZATION (ISO) STANDARD:** [1]

| | |
|---|---|
| **8501-1:1988 (E)** | Color photographic standard for visual assessment of steel substrates |

**2.6 ASTM STANDARD:** [2]

| | |
|---|---|
| **D 5367** | Standard Practice for Evaluating Coatings Applied Over Surfaces Treated With Inhibitors Used to Prevent Flash Rusting of Steel When Water or Water/Abrasive Blasted |

## 3. Procedures For Using Visual Reference Photographs

**3.1 Determine Initial Condition (Rust Grade C or Rust Grade D):** Select the photograph of rust grade that most closely resembles the condition of the steel to be cleaned. Previously painted steel can be classified as either C or D grade, depending on the degree of pitting.

**3.2** Select the photograph that most closely resembles the degree of cleaning that has been specified. For example, if the initial rust grade is D and thorough water jet cleaning is specified (WJ-3, Vis WJ-3), use photograph D Vis WJ 3. (Refer to Section 4.)

**3.3** Immediately after water jetting but before the surface has flash rusted, compare the prepared surface with the photograph selected to evaluate the degree of cleaning (see Appendix A.3).

**3.4** Prior to painting, compare the flash rusted surface with the flash rusting photographs. For example, use D Vis WJ-2 L, D Vis WJ-2 M, or D Vis WJ-2 H to evaluate the degree of flash rusting that has occurred.

[1] ISO standards are available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036, (212) 642-4900.
[2] ASTM, 100 Bar Harbor Drive, West Conshohocken, PA 19428-2959, (610) 832-9500.

Provided by : www.spic.ir Licensee: NISOC Library

**3.5 Degree of Flash Rusting:** The degree of flash rusting specified shall be in accordance with Section 4.3. If no flash rusting is acceptable, the surface must conform to Section 4.2 immediately prior to topcoating. Note: The coating manufacturer may be contacted to verify that the coating material selected is suitable for application over the degree of flash rusting that has occurred. (See Appendix A.3, A.4, A.5 and A.7.)

## 4. Conditions Depicted

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

**4.1.1 Rust Grade C:** Steel surface completely covered with rust, little or no pitting visible (definition taken from SSPC-VIS 1-89).

**4.1.2 Rust Grade D:** Steel surface completely covered with rust, pitting visible (definition taken from SSPC-VIS 1-89).

**4.2 Condition Immediately After Water Jet Cleaning:** The row of visual reference photographs (C WJ-2, C WJ-3, D WJ-2 and D WJ-3) depicts the appearance immediately after water jetting. Steel surfaces show variation in texture, shade, color, tone, pitting, flaking, etc., which should be considered when making comparison with the reference photographs. A brown-black discoloration of ferric oxide may remain as a tightly adherent thin film on corroded and pitted steel and is not considered as part of the percentage staining as described in Sections 4.2.1 and 4.2.2.

**4.2.1 Very Thorough Cleaning (Vis WJ-2):** A Vis WJ-2 surface, when viewed without magnification, shall be cleaned by water jetting to a matte (dull, speckled) finish which is free of all visible oil, grease, paint and rust except for randomly dispersed stains of rust, paint, and other foreign matter. The staining is limited to a maximum of 5% of the surface.

Note: The Vis WJ-2 reference photographs are comparable in degree of staining permitted to C Sa 2-1/2 and D Sa 2-1/2 of ISO 8501:1, and C-SP 10 and D-SP 10 of SSPC-VIS 1-89.

**4.2.2 Thorough Cleaning (Vis WJ-3):** A Vis WJ-3 surface, when viewed without magnification, shall be cleaned by water jetting to a matte (dull, speckled) finish which is free of all visible oil, grease, paint, and rust except for randomly dispersed stains of very thin residues of rust, paint or foreign matter. These stains and residues are limited to a maximum of 33% of the surface and shall be firmly adherent.

Note: The Vis WJ-3 photographs depict a surface cleanliness which has less staining than the allowed maximum of 33% staining. The Vis WJ-3 reference photographs are comparable to C Sa 2 and D Sa 2 of ISO 8501:1 and C-SP 10 and D-SP 10 of SSPC-VIS 1-89.

**4.3 Flash Rusting:** The visual reference photographs also illustrate three degrees of flash rusting. “Flash rusting” or “rust bloom” is a light oxidation of the steel, which occurs as water jet cleaned steel dries off and will quickly change the initial appearance. (See Appendix A.4.)

**4.3.1 Light Flash Rusting (L):** When viewed without magnification, small quantities of light tan-brown rust will partially discolor the original metallic surface. This layer may be evenly distributed or in patches, but it will be tightly adherent and will not be heavy enough to easily mark objects brushed against it.

**4.3.2 Moderate Flash Rusting (M):** When viewed without magnification, a layer of dark tan-brown rust will obscure the original metallic surface. This layer may be evenly distributed, or in patches, but it will be heavy enough to mark objects brushed against it.

**4.3.3 Heavy Flash Rusting (H):** When viewed without magnification, a heavy layer of dark tan-brown rust will completely obscure the original metallic surface. This layer of rust will be loosely adherent and will easily mark objects brushed against it. (See Appendix A.5.)

**4.4 Appearance:** The photographs are illustrative of some variations in color, texture, and general appearance that can result from water jet cleaning. In water jet cleaning, a brown-black discoloration of ferric oxide may remain as a tightly adherent thin film on corroded and pitted steel (see Appendix A.2). The steel surfaces produced by water jetting do NOT look the same as those produced by dry abrasive blasting, or air/water/abrasive (slurry) blasting. This is because water on its own cannot cut or deform steel like abrasives.

**4.4.1** Water jetting will not produce an etch or profile of the magnitude currently recognized by the surface preparation industry; rather, it exposes the original abrasive-blasted surface profile.

**4.4.2** Surfaces cleaned by water jetting tend to look dull, even before they “flash out,” or flash rust. In addition, Grade D steel, with active corrosion pitting, shows a mottled appearance after water jetting. Mottling occurs when the

Provided by : www.spic.ir Licensee: NISOC Library

corrosion products are washed out of the pits leaving a bright patch, and the surrounding areas are left a dull gray, brown to black color. This pattern is the reverse of that left by abrasive blasting, where anodic pits are often dark, due to corrosion products not being entirely removed, and the surrounding areas are bright.

## Appendix A. Notes*

**A.1 Removal of Oil and Grease:** The water jetting process can emulsify and remove oil and grease from a surface as it is cleaned. However, this does not preclude the need for proper degreasing procedures as specified in SSPC-SP 1, "Solvent Cleaning," prior to water jetting.

**A.2 Discoloration of Corroded and Pitted Steel:** The gray, brown to black discoloration seen on corroded and pitted steel after water jetting cannot be removed by further water jetting. Analysis shows that this thin film consists mainly of ferric oxide, which is an inert material. As it is tightly adherent, it does not present a serious contamination problem.

**A.3 Inspecting Water Jet Cleaned Surfaces Prior to Flash Rusting:** When large areas are water jetted, flash rusting obscuring the level of visual cleanliness may occur before an inspection can be carried out. Establishing the required visual cleanliness by cleaning (hydroblasting) a small test area prior to production may help, providing the rest of the job is cleaned to the same degree. Methods for ensuring the rest of the job is cleaned to the same degree will vary from project to project.

**A.4** The temperature of steel substrates can rise during the water jetting process. Compression of the water to reach jetting pressure will create a temperature rise in the water itself, and the velocity of the water striking the steel will impart energy to it as heat. This temperature rise can be substantial, and may help water jetted surfaces dry off more quickly, with a corresponding reduction in the severity of flash rusting. (See Appendix A.3.) Drying with hot air blowers is also a method to reduce the severity of flash rusting.

**A.5 Removal of Flash Rusting:** When flash rusting is too heavy for coating application, some coating manufacturers permit its reduction or removal by clean, hand-held wire brushes or by pressure washing with fresh water. Pressure washing at pressures above 7 MPa (1,000 psi), using either the rotational nozzles, or fan jet lances of the water jetting equipment itself, is a preferred method. It will cause the area to re-rust, but it is possible to reduce the degree of flash rusting from heavy to light using this method. Hand wire or bristle brushing to remove heavy flash rusting may be acceptable for small areas. For large surfaces, mechanical cleaning with power tools can produce acceptable results when the cleaning head does not produce a peened surface or remove the anchor profile needed for coating adhesion.

**A.6 Inspecting Areas of Difficult Access:** Special attention must be given to areas which are difficult to access, such as the backs of stiffening bars. Water cannot be ricocheted into these areas in the same manner as abrasives. Instead, specially designed angled nozzles should be used. These areas should be inspected carefully.

**A.7 Chemical Corrosion Inhibitors:** Flash rusting can be prevented by the use of water soluble chemical corrosion inhibitors. These inhibitors may leave a crystalline layer on the steel surface as the water evaporates, which can then lead to a loss of adhesion and osmotic blistering, if coatings are applied over this type of surface. If inhibitors are used, they should be thoroughly washed off with fresh water. The coating manufacturer should be contacted for compatibility.

See Section 4.3 and Appendix D.1.5 of SSPC-SP 12/ NACE No. 5. ASTM D 5367-94 “Standard Practice for Evaluating Coatings Applied Over Surfaces Treated with Inhibitors Used to Prevent Flash Rusting of Steel When Water or Water/Abrasive Blasted” provides a means for evaluation.

**A.8 Soluble Contaminants Removal:** This visual reference photograph series makes no attempt to define levels of soluble contaminants (salts) remaining on surfaces cleaned by water jetting, or to relate degrees of flash rusting to remaining soluble contaminants. However, the ability to remove chemical contaminants (salts), particularly from badly pitted and corroded steel, is a major advantage of the water jetting process.

*Notes are not requirements of this guide.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# 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 visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from steel surfaces.

**2.2** It is intended that solvent 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 application. Acceptable methods include brushing, blow off with clean, dry air, or vacuum cleaning.

### 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 solvent 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 last 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 procedure 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 applicable federal, state, and local rules and requirements. They also shall be in accord with instructions and requirements of insurance underwriters.

### 7. Notes*

**7.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the standard itself.

**7.2** A Commentary Section is available and contains additional information and data relative to this specification. The Surface Preparation Commentary, SSPC-SP COM, is not part of this specification. The table below lists the subjects discussed relevant to solvent cleaning and appropriate Commentary Section.

Provided by : www.spic.ir Licensee: NISOC Library

| Subject | SSPC-SP COM Section |
|---|---|
| Solvents and Cleaners | 5.1.1 through 5.1.3 |
| Steam Cleaning | 5.1.4 |
| Threshold Limit Values | 5.1.5 |
| Film Thickness | 10 |

*Notes are not requirements of this specification.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# SURFACE PREPARATION SPECIFICATION NO. 2

## Hand Tool Cleaning

### 1. Scope

**1.1** This specification covers the requirements for the hand tool cleaning of steel surfaces.

### 2. Definitions

**2.1** Hand tool cleaning is a method of preparing steel surfaces by the use of non-power hand tools.

**2.2** Hand tool cleaning removes all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife.

**2.3** ISO 8501-1:1988 or other visual standards of surface preparation agreed upon by the contracting parties may be used to further define the surface.

### 3. Reference Standards

**3.1** The standards referenced in this specification listed in Section 3.4 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC SPECIFICATIONS:**

| | |
|---|---|
| **SSPC-SP 1** | Solvent Cleaning |

**3.5 International Organization for Standardization (ISO):**

| | |
|---|---|
| **850-1:1988** | Preparation of steel substrates before application of paints and related products: visual assessment of surface cleanliness, Part I. |

### 4. Surface Preparation Before and After Hand Tool Cleaning

**4.1** Before hand tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP 1.

**4.2** After hand tool cleaning and prior to painting, reclean the surface if it does not conform to this specification.

**4.3** After hand tool cleaning and prior to painting, remove dirt, dust, or similar contaminants from the surface. Acceptable methods include brushing, blow off with clean, dry air, or vacuum cleaning.

### 5. Methods of Hand Tool Cleaning

**5.1** Use impact hand tools to remove stratified rust (rust scale).

**5.2** Use impact hand tools to remove all weld slag.

**5.3** Use hand wire brushing, hand abrading, hand scraping, or other similar non-impact methods to remove all loose mill scale, all loose or non-adherent rust, and all loose paint.

**5.4** Regardless of the method used for cleaning, if specified in the procurement documents, feather edges of remaining old paint so that the repainted surface can have a reasonably smooth appearance.

**5.5** If approved by the owner, use power tools or blast cleaning as a substitute cleaning method for this specification.

### 6. Inspection

**6.1** 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 procedure speci-

Provided by : www.spic.ir Licensee: NISOC Library

fied by the American Arbitration Association shall be used.

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

## 7. Safety

**7.1** All safety requirements stated in this specification and its component parts apply in addition to any applicable federal, state, and local rules and requirements. They also shall be in accord with instructions and requirements of insurance underwriters.

## 8. Notes*

**8.1** While every precaution is taken to insure that all information furnished in SSPC specifications is as accurate, complete, and useful as possible, 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.

**8.2** A Commentary Section is available and contains additional information and data relevant to this specification. The Surface Preparation Commentary, SSPC-SP COM, is not part of this specification. The table below lists the subjects discussed relevant to hand tool cleaning and appropriate Commentary Section.

| | SSPC-SP COM Section |
|---|---|
| Film Thickness | 10 |
| Maintenance Painting | 4.2 |
| Rust Back | 4.5 |
| Visual Standards | 11 |
| Weld Spatter | 4.4.1 |

**8.3** Note that the use of visual standards in conjunction with this specification is required only when they are specified in the procurement documents (project specification) covering the work. It is recommended, however, that the use of visual standards be made mandatory in the procurement documents.

SSPC-VIS 3, “Visual Standard for Power- and Hand-Tool Cleaned Steel,” provides color photographs for the various grades of surface preparation as a function of the initial condition of the steel. For more information about visual standards see SSPC-SP COM, Section 11.

*Notes are not requirements of this specification.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# SURFACE PREPARATION SPECIFICATION NO. 3

## Power Tool Cleaning

### 1. Scope

**1.1** This specification covers the requirements for power tool cleaning of steel surfaces.

### 2. Definition

**2.1** Power tool cleaning is a method of preparing steel surfaces by the use of power assisted hand tools.

**2.2** Power tool cleaning removes all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife.

**2.3** SSPC-VIS 3, ISO 8501-1:1988 or other visual standards of surface preparation agreed upon by the contracting parties may be used to further define the surface.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Section 3.4 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC SPECIFICATIONS:**

| | |
|---|---|
| **SP 1** | Solvent Cleaning |
| **VIS 3** | Visual Standard for Power- and Hand Tool Cleaned Steel |

**3.5 International Organization for Standardization (ISO):**

| | |
|---|---|
| **8501-1:1988** | Preparation of Steel Substrates Before Application of Paints and Related Products: Visual Assessment of Surface Cleanliness, Part I |

### 4. Surface Preparation Before and After Power Tool Cleaning

**4.1** Before power tool cleaning, remove visible oil, grease, soluble welding residue, and salts by the methods outlined in SSPC-SP 1.

**4.2** After power tool cleaning and prior to painting, reclean the surface if it does not conform to this specification.

**4.3** After power tool cleaning and prior to painting, remove dirt, dust, or similar contaminants from the surface. Acceptable methods include brushing, blow off with clean, dry air, or vacuum cleaning.

### 5. Methods of Power Tool Cleaning

**5.1** Use rotary or impact power tools to remove stratified rust (rust scale).

**5.2** Use rotary or impact power tools to remove all weld slag.

**5.3** Use power wire brushing, power abrading, power impact or other power rotary tools to remove all loose mill scale, all loose or non-adherent rust, and all loose paint. Do not burnish the surface.

**5.4** Operate power tools in a manner that prevents the formation of burrs, sharp ridges, and sharp cuts.

**5.5** Regardless of the method used for cleaning, if specified in the procurement documents, feather edges of remaining old paint so that the repainted surface can have a reasonably smooth appearance.

**5.6** if approved by the owner, use blast cleaning as substitute cleaning method for this specification.

### 6. Inspection

**6.1** 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 procure-

Provided by : www.spic.ir Licensee: NISOC Library

ment documents, if any, shall be followed. If no arbitration or settlement procedure is established, the procedure specified by the American Arbitration Association shall be used.

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

## 7. Safety

**7.1** All safety requirements stated in this specification and its component parts apply in addition to any applicable federal, state, and local rules and requirements. They also shall be in accord with instructions and requirements of insurance underwriters.

## 8. Notes*

**8.1** While every precaution is taken to insure that all information furnished in SSPC specifications is as accurate, complete, and useful as possible, 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.

**8.2** A Commentary Section is available and contains additional information and data relevant to this specification.

The Surface Preparation Commentary, SSPC-SP COM, is not part of this specification. The table below lists the subjects discussed relevant to power tool cleaning and appropriate Commentary Section.

| SSPC-SP COM | Section |
|---|---|
| Film Thickness | 10 |
| Rust Back | 4.5 |
| Visual Standards | 11 |
| Weld Spatter | 4.4.1 |

**8.3** Note that the use of visual standards in conjunction with this specification is required only when they are specified in the procurement documents (project specification) covering the work. It is recommended, however, that the use of visual standards be made mandatory in the procurement documents.

SSPC-VIS 3, “Visual Standard for Power- and Hand-Tool Cleaned Steel,” provides color photographs for the various grades of surface preparation as a function of the initial condition of the steel. For more information about visual standards, see SSPC-SP COM, Section 11.

*Notes are not requirements of this specification.

Provided by : www.spic.ir Licensee: NISOC Library

# Joint Surface Preparation Standard

# SSPC-SP 5/NACE NO. 1

## White Metal Blast Cleaning

This SSPC: The Society for Protective Coatings and NACE International standard represents a consensus of those individual members who have reviewed this document, its scope and provisions. Its acceptance does not in any respect preclude anyone, having adopted the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not in conformance with this standard. Nothing contained in this standard is to be construed as granting any right, by implication or otherwise, to manufacture, sell, or use in connection with any method, apparatus, or product covered by Letters Patent, or as indemnifying or protecting anyone against liability for infringement of Letters Patent. This standard represents minimum requirements and should in no way be interpreted as a restriction on the use of better procedures or materials. Neither is this standard intended to apply in all cases relating to the subject. Unpredictable circumstances may negate the usefulness of this standard in specific instances. SSPC and NACE assume no responsibility for the interpretation or use of this standard by other parties and accept responsibility for only those official interpretations issued by SSPC or NACE in accordance with their respective governing procedures and policies, which preclude the issuance of interpretations by individual volunteers.

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

CAUTIONARY NOTICE: SSPC/NACE standards are subject to periodic review and may be revised or withdrawn at any time without prior notice. SSPC and NACE require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of initial publication. The user is cautioned to obtain the latest edition. Purchasers may receive current information on all standards and other publications by contacting the organizations at the addresses below:

©NACE International
P.O. Box 218340
Houston, TX 77218-8340
(telephone +1 281/228-6200)

©SSPC: The Society for Protective Coatings
40 24th Street, Sixth Floor
Pittsburgh, PA 15222
(telephone +1 412/281-2331)

## Foreword

This joint standard covers the use of blast cleaning abrasives to achieve a defined degree of cleaning of steel surfaces prior to the application of a protective coating or lining system. This standard is intended for use by coating or lining specifiers, applicators, inspectors, or others whose responsibility it may be to define a standard degree of surface cleanliness.

The focus of this standard is white metal blast cleaning. Near-white metal blast cleaning, commercial blast cleaning, industrial blast cleaning and brush-off blast cleaning are addressed in separate standards.

White metal blast cleaning provides a greater degree of cleaning than near-white blast cleaning (SSPC-SP 10/NACE No. 2).

The difference between a white metal blast and a near-white blast is that a white metal blast removes all of the coating, mill scale, rust, oxides, corrosion products, and other foreign matter from the surface. Near-white blasting allows light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coating to remain on no more than 5 percent of each unit area of surface.

This joint standard was prepared by the SSPC/NACE Task Group A on Surface Preparation by Abrasive Blast Cleaning. This joint Task Group includes members of both the SSPC Surface Preparation Committee and the NACE Unit Committee T-6G on Surface Preparation.

## 1. General

**1.1** This joint standard covers the requirements for white metal blast cleaning of unpainted or painted steel surfaces by the use of abrasives. These requirements include the end condition of the surface and materials and procedures necessary to achieve and verify the end condition.

Provided by : www.spic.ir Licensee: NISOC Library

**1.2** The mandatory requirements are described in Sections 1 to 9 as follows:

| | |
|---|---|
| Section 1 | General |
| Section 2 | Definition |
| Section 3 | References |
| Section 4 | Procedures Before Blast Cleaning |
| Section 5 | Blast Cleaning Methods and Operation |
| Section 6 | Blast Cleaning Abrasives |
| Section 7 | Procedures Following Blast Cleaning and Immediately Prior to Coating |
| Section 8 | Inspection |
| Section 9 | Safety and Environmental Requirements |

NOTE: Section 10, "Comments" and Appendix A, "Explanatory Notes" are not mandatory requirements of this standard.

## 2. Definition

**2.1** A white metal blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter.

**2.2** Acceptable variations in appearance that do not affect surface cleanliness as defined in Section 2.1 include variations caused by type of steel, original surface condition, thickness of the steel, weld metal, mill or fabrication marks, heat treating, heat affected zones, blasting abrasives, and differences due to blasting technique.

**2.3** When a coating is specified, the surface shall be roughened to a degree suitable for the specified coating system.

**2.4** Immediately prior to coating application, the entire surface shall comply with the degree of cleaning specified herein.

**2.5** SSPC-VIS 1-89 may be specified to supplement the written definition. In any dispute, the written standards shall take precedence over visual standards and comparators. Additional information on visual standards and comparators is available in Section A.4 of Appendix A.

## 3. References

**3.1** The documents referenced in this standard are listed in Section 3.4.

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

**3.3** If there is a conflict between the requirements of any of the cited reference standards and this standard, the requirements of this standard shall prevail.

**3.4 SSPC: The Society For Protective Coatings Standards**:

| | |
|---|---|
| **AB 1** | Mineral and Slag Abrasives |
| **AB 2** | Cleanliness of Recycled Ferrous Metallic Abrasives |
| **AB 3** | Newly Manufactured or Re-Manufactured Steel Abrasives |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **SP 1** | Solvent Cleaning |
| **VIS 1** | Visual Standard for Abrasive Blast Cleaned Steel |

## 4. Procedures Before Blast Cleaning

**4.1** Before blast cleaning, visible deposits of oil, grease, or other contaminants shall be removed in accordance with SSPC-SP 1 or other agreed upon methods.

**4.2** Before blast cleaning, surface imperfections such as sharp fins, sharp edges, weld spatter, or burning slag should be removed from the surface to the extent required by the procurement documents (project specification). Additional information on surface imperfections is available in Section A.5 of Appendix A.

**4.3** If a visual standard or comparator is specified to supplement the written standard, the condition of the steel prior to blast cleaning should be determined before the blasting commences. Additional information on visual standards and comparators is available in Section A.4 of Appendix A.

## 5. Blast Cleaning Methods and Operation

**5.1** Clean, dry compressed air shall be used for nozzle blasting. Moisture separators, oil separators, traps, or other equipment may be necessary to achieve this requirement.

**5.2** Any of the following methods of surface preparation may be used to achieve a white metal abrasive blast cleaned surface:

**5.2.1** Dry abrasive blasting using compressed air, blast nozzles, and abrasive.

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

Provided by : www.spic.ir Licensee: NISOC Library

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

**5.3** Other methods of surface preparation (such as wet abrasive blasting) may be used to achieve a white metal blast cleaned surface by mutual agreement between those responsible for performing the work and those responsible for establishing the requirements. NOTE: Information on the use of inhibitors to prevent the formation of rust immediately after wet blast cleaning is contained in Section A.9 of Appendix A.

## 6. Blast Cleaning Abrasives

**6.1** The selection of abrasive size and type shall be based on the type, grade, and surface condition of the steel to be cleaned, type of blast cleaning system employed, the finished surface to be produced (cleanliness and roughness), and whether the abrasive will be recycled.

**6.2** The cleanliness and size of recycled abrasives shall be maintained to ensure compliance with this specification.

**6.3** The blast cleaning abrasive shall be dry and free of oil, grease, and other contaminants as determined by the test methods found in SSPC-AB 1, AB 2 and AB 3.

**6.4** Any limitations on the use of specific abrasives, the quantity of contaminants, or the degree of allowable embedment shall be included in the procurement documents (project specification) covering the work, because abrasive embedment and abrasives containing contaminants may not be acceptable for some service requirements. NOTE: Additional information on abrasive selection is given in Section A.2 of Appendix A.

## 7. Procedures Following Blast Cleaning and Immediately Prior to Coating

**7.1** Visible deposits of oil, grease, or other contaminants shall be removed according to SSPC-SP 1 or another method agreed upon by those parties responsible for establishing the requirements and those responsible for performing the work.

**7.2** Dust and loose residues shall be removed from prepared surfaces by brushing, blowing off with clean, dry air, vacuum cleaning, or other methods agreed upon by those responsible for establishing the requirements and those responsible for performing the work. NOTE: The presence of toxic metals in the abrasives or paint being removed may place restrictions on the methods of cleaning permitted. Comply with all applicable regulations. Moisture separators, oil separators, traps, or other equipment may be necessary to achieve clean, dry air.

**7.3** After blast cleaning, surface imperfections that remain (e.g., sharp fins, sharp edges, weld spatter, burning slag, scabs, slivers, etc.) shall be removed to the extent required in the procurement documents (project specification). Any damage to the surface profile resulting from the removal of surface imperfections shall be corrected to meet the requirements of Section 2.4. NOTE: Additional information on surface imperfections is contained in Section A.5 of Appendix A.

**7.4** Any visible rust that forms on the surface of the steel after blast cleaning shall be removed by recleaning the rusted areas to meet the requirements of this standard before coating. NOTE: Information on rust-back (re-rusting) and surface condensation is contained in Sections A.6, A.7 and A.8 of Appendix A.

## 8. Inspection

**8.1** Work and materials supplied under this standard are subject to inspection by a representative of those responsible for establishing the requirements. Materials and work areas shall be accessible to the inspector. The procedures and times of inspection shall be as agreed upon by those responsible for establishing the requirements and those responsible for performing the work.

**8.2** Conditions not complying with this standard shall be corrected. In the case of a dispute, an arbitration or settlement procedure established in the procurement documents (project specification) shall be followed. If no arbitration or settlement procedure is established, then a procedure mutually agreeable to purchaser and supplier shall be used.

**8.3** The procurement documents (project specification) should establish the responsibility for inspection and for any required affidavit certifying compliance with the specification.

## 9. Safety and Environmental Requirements

**9.1** Because abrasive blast cleaning is a hazardous operation, all work shall be conducted in compliance with applicable occupational and environmental health and safety rules and regulations. NOTE: SSPC-PA Guide 3, “A Guide to Safety in Paint Application,” addresses safety concerns for coating work.

## 10. Comments

**10.1** Additional information and data relative to this standard are contained in Appendix A. Detailed information and data are presented in a separate document, SSPC-SP COM, “Surface Preparation Commentary.” The recommendations contained in Appendix A and SSPC-SP COM are believed to represent good practice, but are not to be

Provided by : www.spic.ir Licensee: NISOC Library

considered requirements of the standard. The sections of SSPC-SP COM that discuss subjects related to industrial blast cleaning are listed below.

| Subject | Commentary Section |
|---|---|
| Abrasive Selection | 6 |
| Film Thickness | 10 |
| Wet Abrasive Blast Cleaning | 8.2 |
| Maintenance Repainting | 4.2 |
| Rust-back (Re-rusting) | 8.3 |
| Surface Profile | 6.2 |
| Visual Standards | 11 |
| Weld Spatter | 4.4.1 |

## Appendix A. Explanatory Notes

**A.1 FUNCTION:** White metal blast cleaning (SSPC-SP 5/NACE No. 1) provides the greatest degree of cleaning. It should be used when the highest degree of blast cleaning is required. The primary functions of blast cleaning before coating are: (a) to remove material from the surface that can cause early failure of the coating system and (b) to obtain a suitable surface roughness and to enhance the adhesion of the new coating system**.** The hierarchy of blasting standards is as follows: white metal blast cleaning, near-white blast cleaning, commercial blast cleaning, industrial blast cleaning, and brush-off blast cleaning.

**A.2 ABRASIVE SELECTION:** Types of metallic and non-metallic abrasives are discussed in the Surface Preparation Commentary (SSPC-SP COM). It is important to recognize that blasting abrasives may become embedded in or leave residues on the surface of the steel during preparation. While normally such embedment or residues are not detrimental, care should be taken to ensure that the abrasive is free from detrimental amounts of water-soluble, solvent-soluble, acid-soluble, or other soluble contaminants (particularly if the prepared steel is to be used in an immersion environment). Criteria for selecting and evaluating abrasives are given in SSPC-AB 1, "Mineral and Slag Abrasives," SSPC-AB 2, "Cleanliness of Recycled Ferrous Metallic Abrasives," and SSPC-AB 3, "Newly Manufactured or Re-Manufactured Steel Abrasives."

**A.3 SURFACE PROFILE:** Surface profile is the roughness of the surface which results from abrasive blast cleaning. The profile depth (or height) is dependent upon the size, shape, type, and hardness of the abrasive, particle velocity and angle of impact, hardness of the surface, amount of recycling, and the proper maintenance of working mixtures of grit and/or shot.

The allowable minimum/maximum height of profile is usually dependent upon the thickness of the coating to be applied. Large particle sized abrasives (particularly metallic) can produce a profile that may be too deep to be adequately covered by a single thin film coat. Accordingly, it is recommended that the use of larger abrasives be avoided in these cases. However, larger abrasives may be needed for thick film coatings or to facilitate removal of thick coatings, heavy mill scale, or rust. If control of profile (minimum/maximum) is deemed to be significant to coating performance, it should be addressed in the procurement documents (project specification). Typical profile heights achieved with commercial abrasive media are shown in Table 5 of the Surface Preparation Commentary (SSPC-SP COM). Surface profile should be measured in accordance with NACE Standard RP0287 (latest edition), "Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using Replica Tape, " or ASTM[1] D 4417 (latest edition), "Test Method for Field Measurement of Surface Profile of Blast Cleaned Steel."

**A.4 VISUAL STANDARDS:** Note that the use of visual standards or comparators in conjunction with this standard is required only when specified in the procurement document (project specification) covering the work. However, it is strongly recommended that the procurement document require the use of visual standards or comparators. SSPC-VIS 1-89 (Visual Standard for Abrasive Blast Cleaned Steel) provides color photographs for the various grades of surface preparation as a function of the initial condition of the steel. The series A-SP 5, B-SP 5, C-SP 5 and D-SP 5 depict surfaces cleaned to white metal grade. In addition, the series A-SP 5 M and N depict surfaces cleaned by various metallic and non-metallic abrasives to SP 5 condition. The NACE Visual Comparator for Surface Finishing of Welds Prior to Coating is a plastic weld replica that complements NACE Standard RP 0178. Other available visual standards are described in Section 11 of SSPC-SP COM.

**A.5 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 that are difficult to properly cover and protect include crevices, weld porosities, laminations, etc. The high cost of the methods to remedy 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 blast cleaning operation. Other surface defects (steel laminations, weld porosities, or deep corrosion pits) may not be evident until the surface preparation has been completed. Therefore, proper plan-

[1] ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

Provided by : www.spic.ir Licensee: NISOC Library

ning for such surface repair work is essential because the timing of the repairs may occur before, during, or after the blast cleaning operation. Section 4.4 of SSPC-SP COM and NACE Standard RP0178 (latest edition), "Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service" contain additional information on surface imperfections.

**A.6 CHEMICAL CONTAMINATION:** Steel contaminated with soluble salts (e.g., chlorides and sulfates) develops rust-back rapidly at intermediate and high humidities. These soluble salts can be present on the steel surface prior to blast cleaning as a result of atmospheric contamination. In addition, contaminants can be deposited on the steel surface during blast cleaning if the abrasive is contaminated. Therefore, rust-back can be minimized by removing these salts from the steel surface and eliminating sources of recontamination during and after blast cleaning. Wet methods of removal are described in SSPC-SP 12/NACE No. 5. Identification of the contaminants along with their concentrations may be obtained from laboratory and field tests as described in SSPC-TU 4, "Technology Update on Field Methods for Retrieval and Analysis of Soluble Salts on Substrates."

**A.7 RUST-BACK:** Rust-back (re-rusting) occurs when freshly cleaned steel is exposed to moisture, contamination, or a corrosive atmosphere. The time interval between blast cleaning and rust-back will vary greatly from one environment to another. Under mild ambient conditions, if chemical contamination is not present (see Section A.6), it is best to blast clean and coat a surface the same day. Severe conditions may require more expedient coating application to avoid contamination from fallout. Chemical contamination should be removed prior to coating (see Section A.6).

**A.8 DEW POINT:** Moisture condenses on any surface that is colder than the dew point of the surrounding air. It is, therefore, recommended that the temperature of the steel surface be at least 3 °C (5 °F) above the dew point during dry blast cleaning operations. It is advisable to visually inspect for moisture and periodically check the surface temperature and dew point during blast cleaning operations and to avoid the application of coating over a damp surface.

**A.9 WET ABRASIVE BLAST CLEANING**: Steel that is wet abrasive blast cleaned may rust rapidly. Clean water should be used for rinsing. It may be necessary that inhibitors be added to the water or applied to the surface immediately after blast cleaning to temporarily prevent rust formation. The use of inhibitors or the application of coating over slight discoloration should be in accordance with the requirements of the coating manufacturer. CAUTION: Some inhibitive treatments may interfere with the performance of certain coating systems.

**A.10 FILM THICKNESS:** It is essential that ample coating be applied after blast cleaning to adequately cover the peaks of the surface profile. The dry film thickness of the coating above the peaks of the profile should equal the thickness known to be needed for the desired protection. If the dry film thickness over the peaks is inadequate, premature rust-through or failure will occur. To assure that coating thicknesses are properly measured the procedures in SSPC-PA 2 (latest edition), "Measurement of Dry Coating Thickness with Magnetic Gauges" should be used.

**A.11 MAINTENANCE AND REPAIR PAINTING:** When this standard is used in maintenance painting, specific instructions should be given on the extent of surface to be blast cleaned or spot blast cleaned to this degree of cleanliness**.** In these cases, the cleaning shall be performed across the entire area specified. For example, if all weld seams are to be cleaned in a maintenance operation, this degree of cleaning shall be applied 100% to all weld seams. If the entire structure is to be prepared, this degree of cleaning shall be applied to 100% of the entire structure. SSPC-PA Guide 4 (latest edition), "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," provides a description of accepted practices for retaining old sound coating, removing unsound coating, feathering, and spot cleaning.

Provided by : www.spic.ir Licensee: NISOC Library

# Joint Surface Preparation Standard

# SSPC-SP 6/NACE NO. 3

## Commercial Blast Cleaning

This SSPC: The Society for Protective Coatings and NACE International standard represents a consensus of those individual members who have reviewed this document, its scope and provisions. Its acceptance does not in any respect preclude anyone, having adopted the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not in conformance with this standard. Nothing contained in this standard is to be construed as granting any right, by implication or otherwise, to manufacture, sell, or use in connection with any method, apparatus, or product covered by Letters Patent, or as indemnifying or protecting anyone against liability for infringement of Letters Patent. This standard represents minimum requirements and should in no way be interpreted as a restriction on the use of better procedures or materials. Neither is this standard intended to apply in all cases relating to the subject. Unpredictable circumstances may negate the usefulness of this standard in specific instances. SSPC and NACE assume no responsibility for the interpretation or use of this standard by other parties and accept responsibility for only those official interpretations issued by SSPC or NACE in accordance with their respective governing procedures and policies, which preclude the issuance of interpretations by individual volunteers.

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

CAUTIONARY NOTICE: SSPC/NACE standards are subject to periodic review and may be revised or withdrawn at any time without prior notice. SSPC and NACE require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of initial publication. The user is cautioned to obtain the latest edition. Purchasers may receive current information on all standards and other publications by contacting the organizations at the addresses below:

©NACE International
P.O. Box 218340
Houston, TX 77218-8340
(telephone +1 281/228-6200)

©SSPC: The Society for Protective Coatings
40 24th Street, Sixth Floor
Pittsburgh, PA 15222
(telephone +1 412/281-2321)

### Foreword

This joint standard covers the use of blast cleaning abrasives to achieve a defined degree of cleaning of steel surfaces prior to the application of a protective coating or lining system. This standard is intended for use by coating or lining specifiers, applicators, inspectors, or others whose responsibility it may be to define a standard degree of surface cleanliness.

The focus of this standard is commercial blast cleaning. White metal blast cleaning, near-white blast cleaning, industrial blast cleaning, and brush-off blast cleaning are addressed in separate standards.

Commercial blast cleaning provides a greater degree of cleaning than industrial blast cleaning (SSPC-SP 14/NACE No. 8), but less than near-white blast cleaning (SSPC-SP 10/NACE No. 2).

Commercial blast cleaning is used when the objective is to remove all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter, leaving staining or shadows on no more than 33 percent of each unit area of surface as described in Section 2.2.

The difference between a commercial blast and a near-white blast is in the amount of staining permitted to remain on the surface. Commercial blast allows stains or shadows on 33 percent of each unit area of surface. Near-white blast allows staining or shadows on only 5 percent of each unit area.

The difference between a commercial blast and an industrial blast is that a commercial blast removes all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter from all surfaces and allows stains to remain on 33 percent of each unit area of surface, while industrial blast allows defined mill scale, coating, and rust to remain on less than 10 percent of the surface and allows defined stains to remain on all surfaces.

Provided by : www.spic.ir Licensee: NISOC Library

This joint standard was prepared by the SSPC/NACE Task Group A on Surface Preparation by Abrasive Blast Cleaning. This joint Task Group includes members of both the SSPC Surface Preparation Committee and the NACE Unit Committee T-6G on Surface Preparation.

## 1. General

**1.1** This joint standard covers the requirements for commercial blast cleaning of unpainted or painted steel surfaces by the use of abrasives. These requirements include the end condition of the surface and materials and procedures necessary to achieve and verify the end condition.

**1.2** The mandatory requirements are described in Sections 1 to 9 as follows:

| | |
|---|---|
| Section 1 | General |
| Section 2 | Definition |
| Section 3 | References |
| Section 4 | Procedures Before Blast Cleaning |
| Section 5 | Blast Cleaning Methods and Operation |
| Section 6 | Blast Cleaning Abrasives |
| Section 7 | Procedures Following Blast Cleaning and Immediately Prior to Coating |
| Section 8 | Inspection |
| Section 9 | Safety and Environmental Requirements |

NOTE: Section 10, "Comments" and Appendix A, "Explanatory Notes" are not mandatory requirements of this standard.

## 2. Definition

**2.1** A commercial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter, except for staining as noted in Section 2.2.

**2.2** Random staining shall be limited to no more than 33 percent of each unit area of surface as defined in Section 2.6, and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coating.

**2.3** Acceptable variations in appearance that do not affect surface cleanliness as defined in Section 2.1 include variations caused by type of steel, original surface condition, thickness of the steel, weld metal, mill or fabrication marks, heat treating, heat affected zones, blasting abrasives, and differences due to blasting technique.

**2.4** When a coating is specified, the surface shall be roughened to a degree suitable for the specified coating system.

**2.5** Immediately prior to coating application, the entire surface shall comply with the degree of cleaning specified herein.

**2.6** Unit area for determinations shall be approximately 5776 $mm^2$ (9 $in^2$) (i.e., a square 76 x 76 mm [3 in x 3 in]).

**2.7** SSPC-VIS 1-89 may be specified to supplement the written definition. In any dispute, the written standards shall take precedence over visual standards and comparators. Additional information on visual standards and comparators is available in Section A.4 of Appendix A.

## 3. References

**3.1** The documents referenced in this standard are listed in Section 3.4.

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

**3.3** If there is a conflict between the requirements of any of the cited reference standards and this standard, the requirements of this standard shall prevail.

**3.4 SSPC: THE SOCIETY FOR PROTECTIVE COATINGS STANDARDS:**

| | |
|---|---|
| **AB 1** | Mineral and Slag Abrasives |
| **AB 2** | Cleanliness of Recycled Ferrous Metallic Abrasives |
| **AB 3** | Newly Manufactured or Re-Manufactured Steel Abrasives |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **SP 1** | Solvent Cleaning |
| **VIS 1-89** | Visual Standard for Abrasive Blast Cleaned Steel |

## 4. Procedures Before Blast Cleaning

**4.1** Before blast cleaning, visible deposits of oil, grease, or other contaminants shall be removed in accordance with SSPC-SP 1 or other agreed upon methods.

**4.2** Before blast cleaning, surface imperfections such as sharp fins, sharp edges, weld spatter, or burning slag should be removed from the surface to the extent required by the procurement documents (project specification). Additional information on surface imperfections is available in Section A.5 of Appendix A.

**4.3** If a visual standard or comparator is specified to supplement the written standard, the condition of the steel prior to blast cleaning should be determined before the blasting commences. Additional information on visual standards and comparators is available in Section A.4 of Appendix A.

Provided by : www.spic.ir Licensee: NISOC Library

## 5. Blast Cleaning Methods and Operation

**5.1** Clean, dry compressed air shall be used for nozzle blasting. Moisture separators, oil separators, traps, or other equipment may be necessary to achieve this requirement.

**5.2** Any of the following methods of surface preparation may be used to achieve a commercial blast cleaned surface:

**5.2.1** Dry abrasive blasting using compressed air, blast nozzles, and abrasive.

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

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

**5.3** Other methods of surface preparation (such as wet abrasive blasting) may be used to achieve a commercial blast cleaned surface by mutual agreement between those responsible for performing the work and those responsible for establishing the requirements. NOTE: Information on the use of inhibitors to prevent the formation of rust immediately after wet blast cleaning is contained in Section A.9 of Appendix A.

## 6. Blast Cleaning Abrasives

**6.1** The selection of abrasive size and type shall be based on the type, grade, and surface condition of the steel to be cleaned, type of blast cleaning system employed, the finished surface to be produced (cleanliness and roughness), and whether the abrasive will be recycled.

**6.2** The cleanliness and size of recycled abrasives shall be maintained to ensure compliance with this specification.

**6.3** The blast cleaning abrasive shall be dry and free of oil, grease, and other contaminants as determined by the test methods found in SSPC-AB 1, AB 2 and AB 3.

**6.4** Any limitations on the use of specific abrasives, the quantity of contaminants, or the degree of allowable embedment shall be included in the procurement documents (project specification) covering the work, because abrasive embedment and abrasives containing contaminants may not be acceptable for some service requirements. NOTE: Additional information on abrasive selection is given in Section A.2 of Appendix A.

## 7. Procedures Following Blast Cleaning and Immediately Prior to Coating

**7.1** Visible deposits of oil, grease, or other contaminants shall be removed according to SSPC-SP 1 or another method agreed upon by those parties responsible for establishing the requirements and those responsible for performing the work.

**7.2** Dust and loose residues shall be removed from prepared surfaces by brushing, blowing off with clean, dry air, vacuum cleaning, or other methods agreed upon by those responsible for establishing the requirements and those responsible for performing the work. NOTE: The presence of toxic metals in the abrasives or paint being removed may place restrictions on the methods of cleaning permitted. Comply with all applicable regulations. Moisture separators, oil separators, traps, or other equipment may be necessary to achieve clean, dry air.

**7.3** After blast cleaning, surface imperfections that remain (e.g., sharp fins, sharp edges, weld spatter, burning slag, scabs, slivers, etc.) shall be removed to the extent required in the procurement documents (project specification). Any damage to the surface profile resulting from the removal of surface imperfections shall be corrected to meet the requirements of Section 2.4. NOTE: Additional information on surface imperfections is contained in Section A.5 of Appendix A.

**7.4** Any visible rust that forms on the surface of the steel after blast cleaning shall be removed by recleaning the rusted areas to meet the requirements of this standard before coating. NOTE: Information on rust-back (re-rusting) and surface condensation is contained in Sections A.6, A.7 and A.8 of Appendix A.

## 8. Inspection

**8.1** Work and materials supplied under this standard are subject to inspection by a representative of those responsible for establishing the requirements. Materials and work areas shall be accessible to the inspector. The procedures and times of inspection shall be as agreed upon by those responsible for establishing the requirements and those responsible for performing the work.

**8.2** Conditions not complying with this standard shall be corrected. In the case of a dispute, an arbitration or settlement procedure established in the procurement documents (project specification) shall be followed. If no arbitration or settlement procedure is established, then a procedure mutually agreeable to purchaser and supplier shall be used.

Provided by : www.spic.ir Licensee: NISOC Library

**8.3** The procurement documents (project specification) should establish the responsibility for inspection and for any required affidavit certifying compliance with the specification.

## 9. Safety and Environmental Requirements

**9.1** Because abrasive blast cleaning is a hazardous operation, all work shall be conducted in compliance with applicable occupational and environmental health and safety rules and regulations. NOTE: SSPC-PA Guide 3, "A Guide to Safety in Paint Application," addresses safety concerns for coating work.

## 10. Comments

**10.1** Additional information and data relative to this standard are contained in Appendix A. Detailed information and data are presented in a separate document, SSPC-SP COM, "Surface Preparation Commentary." The recommendations contained in Appendix A and SSPC-SP COM are believed to represent good practice, but are not to be considered requirements of the standard. The sections of SSPC-SP COM that discuss subjects related to industrial blast cleaning are listed below.

| Subject | Commentary Section |
|---|---|
| Abrasive Selection | 6 |
| Film Thickness | 10 |
| Wet Abrasive Blast Cleaning | 8.2 |
| Maintenance Repainting | 4.2 |
| Rust-back (Re-rusting) | 8.3 |
| Surface Profile | 6.2 |
| Visual Standards | 11 |
| Weld Spatter | 4.4.1 |

## Appendix A. Explanatory Notes

**A.1 FUNCTION:** Commercial blast cleaning (SSPC-SP 6/NACE No. 3) provides a greater degree of cleaning than brush-off blast cleaning (SSPC-SP 7/NACE No. 4), but less than near-white blast cleaning (SSPC-SP 10/NACE No. 2). It should be specified only when a compatible coating will be applied. The primary functions of blast cleaning before coating are: (a) to remove material from the surface that can cause early failure of the coating system and (b) to obtain a suitable surface roughness and to enhance the adhesion of the new coating system. The hierarchy of blasting standards is as follows: white metal blast cleaning, near-white blast cleaning, commercial blast cleaning, industrial blast cleaning, and brush-off blast cleaning.

**A.2 ABRASIVE SELECTION:** Types of metallic and non-metallic abrasives are discussed in the Surface Preparation Commentary (SSPC-SP COM). It is important to recognize that blasting abrasives may become embedded in or leave residues on the surface of the steel during preparation. While normally such embedment or residues are not detrimental, care should be taken to ensure that the abrasive is free from detrimental amounts of water-soluble, solvent-soluble, acid-soluble, or other soluble contaminants (particularly if the prepared steel is to be used in an immersion environment). Criteria for selecting and evaluating abrasives are given in SSPC-AB 1, "Mineral and Slag Abrasives," SSPC-AB 2, "Cleanliness of Recycled Ferrous Metallic Abrasives," and SSPC-AB 3, "Newly Manufactured or Re-Manufactured Steel Abrasives."

**A.3 SURFACE PROFILE:** Surface profile is the roughness of the surface which results from abrasive blast cleaning. The profile depth (or height) is dependent upon the size, shape, type, and hardness of the abrasive, particle velocity and angle of impact, hardness of the surface, amount of recycling, and the proper maintenance of working mixtures of grit and/or shot.

The allowable minimum/maximum height of profile is usually dependent upon the thickness of the coating to be applied. Large particle sized abrasives (particularly metallic) can produce a profile that may be too deep to be adequately covered by a single thin film coat. Accordingly, it is recommended that the use of larger abrasives be avoided in these cases. However, larger abrasives may be needed for thick film coatings or to facilitate removal of thick coatings, heavy mill scale, or rust. If control of profile (minimum/maximum) is deemed to be significant to coating performance, it should be addressed in the procurement documents (project specification). Typical profile heights achieved with commercial abrasive media are shown in Table 5 of the Surface Preparation Commentary (SSPC-SP COM). Surface profile should be measured in accordance with NACE Standard RP0287 (latest edition), "Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using Replica Tape,"or ASTM[1] D 4417 (latest edition), "Test Method for Field Measurement of Surface Profile of Blast Cleaned Steel."

**A.4 VISUAL STANDARDS:** SSPC-VIS 1-89 (Visual Standard for Abrasive Blast Cleaned Steel) provides color photographs for the various grades of surface preparation as a function of the initial condition of the steel. The A-SP 6, B-SP 6, C-SP 6 and D-SP 6 series of photographs depict surfaces cleaned to a commercial blast. Other available visual standards are described in Section 11 of SSPC-SP COM.

**A.5 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 that are difficult to properly cover and protect include crevices, weld porosities, laminations,

[1] ASTM, 100 Barr Harbor Drive, West Conshohocken PA 19428-2959.



Provided by : www.spic.ir Licensee: NISOC Library

etc. The high cost of the methods to remedy 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 blast cleaning operation. Other surface defects (steel laminations, weld porosities, or deep corrosion pits) may not be evident until the surface preparation has been completed. Therefore, proper planning for such surface repair work is essential because the timing of the repairs may occur before, during, or after the blast cleaning operation. Section 4.4 of SSPC-SP COM and NACE Standard RP0178 (latest edition), "Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service" contain additional information on surface imperfections.

**A.6 CHEMICAL CONTAMINATION:** Steel contaminated with soluble salts (e.g., chlorides and sulfates) develops rust-back rapidly at intermediate and high humidities. These soluble salts can be present on the steel surface prior to blast cleaning as a result of atmospheric contamination. In addition, contaminants can be deposited on the steel surface during blast cleaning if the abrasive is contaminated. Therefore, rust-back can be minimized by removing these salts from the steel surface and eliminating sources of recontamination during and after blast cleaning. Wet methods of removal are described in SSPC-SP 12/NACE No. 5. Identification of the contaminants along with their concentrations may be obtained from laboratory and field tests as described in SSPC-TU 4, "Technology Update on Field Methods for Retrieval and Analysis of Soluble Salts on Substrates."

**A.7 RUST-BACK:** Rust-back (re-rusting) occurs when freshly cleaned steel is exposed to moisture, contamination, or a corrosive atmosphere. The time interval between blast cleaning and rust-back will vary greatly from one environment to another. Under mild ambient conditions, if chemical contamination is not present (see Section A.6), it is best to blast clean and coat a surface the same day. Severe conditions may require more expedient coating application to avoid contamination from fallout. Chemical contamination should be removed prior to coating (see Section A.6).

**A.8 DEW POINT:** Moisture condenses on any surface that is colder than the dew point of the surrounding air. It is, therefore, recommended that the temperature of the steel surface be at least 3 °C (5 °F) above the dew point during dry blast cleaning operations. It is advisable to visually inspect for moisture and periodically check the surface temperature and dew point during blast cleaning operations and to avoid the application of coating over a damp surface.

**A.9 WET ABRASIVE BLAST CLEANING:** Steel that is wet abrasive blast cleaned may rust rapidly. Clean water should be used for rinsing. It may be necessary that inhibitors be added to the water or applied to the surface immediately after blast cleaning to temporarily prevent rust formation. The use of inhibitors or the application of coating over slight discoloration should be in accordance with the requirements of the coating manufacturer. CAUTION: Some inhibitive treatments may interfere with the performance of certain coating systems.

**A.10 FILM THICKNESS:** It is essential that ample coating be applied after blast cleaning to adequately cover the peaks of the surface profile. The dry film thickness of the coating above the peaks of the profile should equal the thickness known to be needed for the desired protection. If the dry film thickness over the peaks is inadequate, premature rust-through or failure will occur. To assure that coating thicknesses are properly measured the procedures in SSPC-PA 2 (latest edition), "Measurement of Dry Coating Thickness with Magnetic Gauges" should be used.

**A.11 MAINTENANCE AND REPAIR PAINTING:** When this standard is used in maintenance painting, specific instructions should be given on the extent of surface to be blast cleaned or spot blast cleaned to this degree of cleanliness. In these cases, the cleaning shall be performed across the entire area specified. For example, if all weld seams are to be cleaned in a maintenance operation, this degree of cleaning shall be applied 100% to all weld seams. If the entire structure is to be prepared, this degree of cleaning shall be applied to 100% of the entire structure. SSPC-PA Guide 4 (latest edition), "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," provides a description of accepted practices for retaining old sound coating, removing unsound coating, feathering, and spot cleaning.

Provided by : www.spic.ir Licensee: NISOC Library

# Joint Surface Preparation Standard

# SSPC-SP 7/NACE NO. 4

## Brush-Off Blast Cleaning

This SSPC: The Society for Protective Coatings and NACE International standard represents a consensus of those individual members who have reviewed this document, its scope and provisions. Its acceptance does not in any respect preclude anyone, having adopted the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not in conformance with this standard. Nothing contained in this standard is to be construed as granting any right, by implication or otherwise, to manufacture, sell, or use in connection with any method, apparatus, or product covered by Letters Patent, or as indemnifying or protecting anyone against liability for infringement of Letters Patent. This standard represents minimum requirements and should in no way be interpreted as a restriction on the use of better procedures or materials. Neither is this standard intended to apply in all cases relating to the subject. Unpredictable circumstances may negate the usefulness of this standard in specific instances. SSPC and NACE assume no responsibility for the interpretation or use of this standard by other parties and accept responsibility for only those official interpretations issued by SSPC or NACE in accordance with their respective governing procedures and policies, which preclude the issuance of interpretations by individual volunteers.

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

CAUTIONARY NOTICE: SSPC/NACE standards are subject to periodic review and may be revised or withdrawn at any time without prior notice. SSPC and NACE require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of initial publication. The user is cautioned to obtain the latest edition. Purchasers may receive current information on all standards and other publications by contacting the organizations at the addresses below:

©NACE International
P.O. Box 218340
Houston, TX 77218-8340
(telephone +1 281/228-6200)

©SSPC: The Society for Protective Coatings
40 24th Street, Sixth Floor
Pittsburgh, PA 15222
(telephone +1 412/281-2331)

## Foreword

This joint standard covers the use of blast cleaning abrasives to achieve a defined degree of cleaning of steel surfaces prior to the application of a protective coating or lining system. This standard is intended for use by coating or lining specifiers, applicators, inspectors, or others whose responsibility it may be to define a standard degree of surface cleanliness.

The focus of this standard is brush-off blast cleaning. White metal blast cleaning, near-white blast cleaning, commercial blast cleaning, and industrial blast cleaning are addressed in separate standards.

Brush-off blast cleaning provides a lesser degree of cleaning than industrial blast cleaning (SSPC-SP 14/NACE No. 8). The difference between an industrial blast and a brush-off blast is that the objective of a brush-off blast is to allow as much of an existing coating to remain as possible, and to roughen the surface prior to coating application while the purpose of the industrial blast is to remove most of the coating, mill scale and rust, when the extra effort required to remove every trace of these is determined to be unwarranted.

This joint standard was prepared by the SSPC/NACE Task Group A on Surface Preparation by Abrasive Blast Cleaning. This joint Task Group includes members of both the SSPC Surface Preparation Committee and the NACE Unit Committee T-6G on Surface Preparation.

## 1. General

**1.1** This joint standard covers the requirements for brush-off blast cleaning of unpainted or painted steel surfaces by the use of abrasives. These requirements include the end condition of the surface and materials and procedures necessary to achieve and verify the end condition.

Provided by : www.spic.ir Licensee: NISOC Library

**1.2** This joint standard allows tightly adherent rust, mill scale and/or old coating to remain on the surface.

**1.3** The mandatory requirements are described in Sections 1 to 9 as follows:

| | |
|---|---|
| Section 1 | General |
| Section 2 | Definitions |
| Section 3 | References |
| Section 4 | Procedures Before Blast Cleaning |
| Section 5 | Blast Cleaning Methods and Operation |
| Section 6 | Blast Cleaning Abrasives |
| Section 7 | Procedures Following Blast Cleaning and Immediately Prior to Coating |
| Section 8 | Inspection |
| Section 9 | Safety and Environmental Requirements |

NOTE: Section 10, "Comments" and Appendix A, "Explanatory Notes" are not mandatory requirements of this standard.

## 2. Definition

**2.1** A brush-off blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose coating. Tightly adherent mill scale, rust, and coating may remain on the surface. Mill scale, rust, and coating are considered tightly adherent if they cannot be removed by lifting with a dull putty knife after abrasive blast cleaning has been performed.

**2.2** The entire surface shall be subjected to the abrasive blast. The remaining mill scale, rust, or coating shall be tight. Flecks of the underlying steel need not be exposed whenever the original substrate consists of intact coating.

**2.3** When a coating is specified, the surface shall be roughened to a degree suitable for the specified coating system.

**2.4** Immediately prior to coating application, the entire surface shall comply with the degree of cleaning as specified herein.

**2.5** Visual standards or comparators may be specified to supplement the written definition. In any dispute, the written standards shall take precedence over visual standards and comparators. Additional information on visual standards is available in Section A.4 of Appendix A.

## 3. References

**3.1** The documents referenced in this standard are listed in Section 3.4.

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

**3.3** If there is a conflict between the requirements of any of the cited reference standards and this standard, the requirements of this standard shall prevail.

**3.4 SSPC: THE SOCIETY FOR PROTECTIVE COATINGS STANDARDS:**

| | |
|---|---|
| **AB 1** | Mineral and Slag Abrasives |
| **AB 2** | Cleanliness of Recycled Ferrous Metallic Abrasives |
| **AB 3** | Newly Manufactured or Re-Manufactured Steel Abrasives |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **SP 1** | Solvent Cleaning |
| **VIS 1-89** | Visual Standard for Abrasive Blast Cleaned Steel |

## 4. Procedures Before Blast Cleaning

**4.1** Before blast cleaning, visible deposits of oil, grease, or other contaminants shall be removed in accordance with SSPC-SP 1 or other agreed upon methods.

**4.2** Before blast cleaning, surface imperfections such as sharp fins, sharp edges, weld spatter, or burning slag should be removed from the surface to the extent required by the procurement documents (project specification). Additional information on surface imperfections is available in Section A.5 of Appendix A.

**4.3** If a visual standard or comparator is specified to supplement the written standard, the condition of the steel prior to blast cleaning should be determined before the blasting commences. Additional information on visual standards and comparators is available in Section A.4 of Appendix A.

## 5. Blast Cleaning Methods and Operation

**5.1** Clean, dry compressed air shall be used for nozzle blasting. Moisture separators, oil separators, traps, or other equipment may be necessary to achieve this requirement.

**5.2** Any of the following methods of surface preparation may be used to achieve a brush-off blast cleaned surface:

**5.2.1** Dry abrasive blasting using compressed air, blast nozzles, and abrasive.

**5.2.2** Dry abrasive blasting using a closed-cycle, recirculating abrasive system with compressed air, blast nozzle,

Provided by : www.spic.ir Licensee: NISOC Library

and abrasive, with or without vacuum for dust and abrasive recovery.

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

**5.3** Other methods of surface preparation (such as wet abrasive blasting) may be used to achieve a brush-off blast cleaned surface by mutual agreement between those responsible for performing the work and those responsible for establishing the requirements. NOTE: Information on the use of inhibitors to prevent the formation of rust immediately after wet blast cleaning is contained in Section A.9 of Appendix A.

## 6. Blast Cleaning Abrasives

**6.1** The selection of abrasive size and type shall be based on the type, grade, and surface condition of the steel to be cleaned, type of blast cleaning system employed, the finished surface to be produced (cleanliness and roughness), and whether the abrasive will be recycled.

**6.2** The cleanliness and size of recycled abrasives shall be maintained to ensure compliance with this specification.

**6.3** The blast cleaning abrasive shall be dry and free of oil, grease, and other contaminants as determined by the test methods found in SSPC-AB 1, AB 2 and AB 3.

**6.4** Any limitations on the use of specific abrasives, the quantity of contaminants, or the degree of allowable embedment shall be included in the procurement documents (project specification) covering the work, because abrasive embedment and abrasives containing contaminants may not be acceptable for some service requirements. NOTE: Additional information on abrasive selection is given in Section A.2 of Appendix A.

## 7. Procedures Following Blast Cleaning and Immediately Prior to Coating

**7.1** Visible deposits of oil, grease, or other contaminants shall be removed according to SSPC-SP 1 or another method agreed upon by those parties responsible for establishing the requirements and those responsible for performing the work.

**7.2** Dust and loose residues shall be removed from prepared surfaces by brushing, blowing off with clean, dry air, vacuum cleaning, or other methods agreed upon by those responsible for establishing the requirements and those responsible for performing the work. NOTE: The presence of toxic metals in the abrasives or paint being removed may place restrictions on the methods of cleaning permitted. The method chosen shall comply with all applicable regulations. Moisture separators, oil separators, traps, or other equipment may be necessary to achieve clean, dry air.

**7.3** After blast cleaning, surface imperfections that remain (e.g., sharp fins, sharp edges, weld spatter, burning slag, scabs, slivers, etc.) shall be removed to the extent required in the procurement documents (project specification). Any damage to the surface profile resulting from the removal of surface imperfections shall be corrected to meet the requirements of Section 2.4. NOTE: Additional information on surface imperfections is contained in Section A.5 of Appendix A.

## 8. Inspection

**8.1** Work and materials supplied under this standard are subject to inspection by a representative of those responsible for establishing the requirements. Materials and work areas shall be accessible to the inspector. The procedures and times of inspection shall be as agreed upon by those responsible for establishing the requirements and those responsible for performing the work.

**8.2** Conditions not complying with this standard shall be corrected. In the case of a dispute, an arbitration or settlement procedure established in the procurement documents (project specification) shall be followed. If no arbitration or settlement procedure is established, then a procedure mutually agreeable to purchaser and supplier shall be used.

**8.3** The procurement documents (project specification) should establish the responsibility for inspection and for any required affidavit certifying compliance with the specification.

## 9. Safety and Environmental Requirements

**9.1** Because abrasive blast cleaning is a hazardous operation, all work shall be conducted in compliance with applicable occupational and environmental health and safety rules and regulations. NOTE: SSPC-PA Guide 3, “A Guide to Safety in Paint Application,” addresses safety concerns for coating work.

## 10. Comments

**10.1** Additional information and data relative to this standard are contained in Appendix A. Detailed information and data are presented in a separate document, SSPC-SP COM, “Surface Preparation Commentary.” The recommendations contained in Appendix A and SSPC-SP COM are believed to represent good practice, but are not to be considered requirements of the standard. The sections of SSPC-SP COM that discuss subjects related to brush-off

Provided by : www.spic.ir Licensee: NISOC Library

blast cleaning are listed below.

| Subject | Commentary Section |
|---|---|
| Abrasive Selection | 6 |
| Film Thickness | 10 |
| Wet Abrasive Blast Cleaning | 8.2 |
| Maintenance Repainting | 4.2 |
| Rust-back (Re-rusting) | 8.3 |
| Surface Profile | 6.2 |
| Visual Standards | 11 |
| Weld Spatter | 4.4.1 |

## Appendix A. Explanatory Notes

**A.1 FUNCTION:** Brush-off blast cleaning (SSPC-SP 7/ NACE No. 4), provides a lesser degree of cleaning than industrial blast cleaning (SSPC-SP 14/NACE No. 8). It should be used when the service environment is mild enough to permit tight mill scale, coating, rust, and other foreign matter to remain on the surface. The primary functions of blast cleaning before coating are (a) to remove material from the surface that can cause early failure of the coating and (b) to obtain a suitable surface roughness and to enhance the adhesion of the new coating system. The hierarchy of blasting standards is as follows: white metal blast cleaning, near-white blast cleaning, commercial blast cleaning, industrial blast cleaning, and brush-off blast cleaning.

**A.2 ABRASIVE SELECTION:** Types of metallic and non-metallic abrasives are discussed in the Surface Preparation Commentary (SSPC-SP COM). It is important to recognize that blasting abrasives may become embedded in or leave residues on the surface of the steel during preparation. While normally such embedment or residues are not detrimental, care should be taken to ensure that the abrasive is free from detrimental amounts of water-soluble, solvent-soluble, acid-soluble, or other soluble contaminants (particularly if the prepared steel is to be used in an immersion environment). Criteria for selecting and evaluating abrasives are given in SSPC-AB 1, "Mineral and Slag Abrasives," SSPC-AB 2, "Cleanliness of Recycled Ferrous Metallic Abrasives," and SSPC-AB 3, "Newly Manufactured or Re-Manufactured Steel Abrasives."

**A.3 SURFACE PROFILE:** Surface profile is the roughness of the surface which results from abrasive blast cleaning. The profile depth (or height) is dependent upon the size, shape, type, and hardness of the abrasive, particle velocity and angle of impact, hardness of the surface, amount of recycling, and the proper maintenance of working mixtures of grit and/or shot.

The allowable minimum/maximum height of profile is usually dependent upon the thickness of the coating to be applied. Large particle sized abrasives (particularly metallic) can produce a profile that may be too deep to be adequately covered by a single thin film coat. Accordingly, it is recommended that the use of larger abrasives be avoided in these cases. However, larger abrasives may be needed for thick film coatings or to facilitate removal of thick coatings, heavy mill scale, or rust. If control of profile (minimum/maximum) is deemed to be significant to coating performance, it should be addressed in the procurement documents (project specification). Typical profile heights achieved with commercial abrasive media are shown in Table 5 of the Surface Preparation Commentary (SSPC-SP COM). Surface profile should be measured in accordance with NACE Standard RP0287 (latest edition), "Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using Replica Tape, " or ASTM[1] D 4417 (latest edition), "Test Method for Field Measurement of Surface Profile of Blast Cleaned Steel."

**A.4 VISUAL STANDARDS:** SSPC-VIS 1-89 (Visual Standard for Abrasive Blast Cleaned Steel) provides color photographs for the various grades of surface preparation as a function of the initial condition of the steel. The series A-SP 7, B-SP 7, C-SP 7 and D-SP 7 depict surfaces cleaned to brush-off blast grade. Other available visual standards are described in Section 11 of SSPC-SP COM.

**A.5 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 that are difficult to properly cover and protect include crevices, weld porosities, laminations, etc. The high cost of the methods to remedy 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 blast cleaning operation. Other surface defects (steel laminations, weld porosities, or deep corrosion pits) may not be evident until the surface preparation has been completed. Therefore, proper planning for such surface repair work is essential because the timing of the repairs may occur before, during, or after the blast cleaning operation. Section 4.4 of SSPC-SP COM and NACE Standard RP0178 (latest edition), "Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service" contain additional information on surface imperfections.

**A.6 CHEMICAL CONTAMINATION:** Steel contaminated with soluble salts (e.g., chlorides and sulfates) develops rust-back rapidly at intermediate and high humidities.

[1] ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.



Provided by : www.spic.ir Licensee: NISOC Library

These soluble salts can be present on the steel surface prior to blast cleaning as a result of atmospheric contamination. In addition, contaminants can be deposited on the steel surface during blast cleaning if the abrasive is contaminated. Therefore, rust-back can be minimized by removing these salts from the steel surface, preferably before blast cleaning, and eliminating sources of recontamination during and after blast cleaning. Wet methods of removal are described in SSPC-SP 12/NACE No. 5. Identification of the contaminants along with their concentrations may be obtained from laboratory and field tests as described in SSPC-TU 4, "Technology Update on Field Methods for Retrieval and Analysis of Soluble Salts on Substrates."

**A.7 RUST-BACK:** Rust-back (re-rusting) occurs when freshly cleaned steel is exposed to moisture, contamination, or a corrosive atmosphere. The time interval between blast cleaning and rust-back will vary greatly from one environment to another. Under mild ambient conditions, if chemical contamination is not present (see Section A.6), it is best to blast clean and coat a surface the same day. Severe conditions may require more expedient coating application to avoid contamination from fallout. Chemical contamination should be removed prior to coating (see Section A.6).

**A.8 DEW POINT:** Moisture condenses on any surface that is colder than the dew point of the surrounding air. It is, therefore, recommended that the temperature of the steel surface be at least 3 °C (5 °F) above the dew point during dry blast cleaning operations. It is advisable to visually inspect for moisture and periodically check the surface temperature and dew point during blast cleaning operations and to avoid the application of coating over a damp surface.

**A.9 WET ABRASIVE BLAST CLEANING:** Steel that is wet abrasive blast cleaned may rust rapidly. Clean water should be used for rinsing. It may be necessary that inhibitors 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. The use of inhibitors or the application of coating over slight discoloration should be in accordance with the requirements of the coating manufacturer. CAUTION: Some inhibitive treatments may interfere with the performance of certain coating systems.

**A.10 FILM THICKNESS:** It is essential that ample coating be applied after blast cleaning to adequately cover the peaks of the surface profile. The dry film thickness of the coating above the peaks of the profile should equal the thickness known to be needed for the desired protection. If the dry film thickness over the peaks is inadequate, premature rust-through or failure will occur. To assure that coating thicknesses are properly measured the procedures in SSPC-PA 2 (latest edition), "Measurement of Dry Coating Thickness with Magnetic Gauges" should be used.

**A.11 MAINTENANCE AND REPAIR COATING:** When this standard is used in maintenance painting, specific instructions should be given on the extent of surface to be blast cleaned or spot blast cleaned to this degree of cleanliness. In these cases, the cleaning shall be performed across the entire area specified. For example, if all weld seams are to be cleaned in a maintenance operation, this degree of cleaning shall be applied 100% to all weld seams. If the entire structure is to be prepared, this degree of cleaning shall be applied to 100% of the entire structure. SSPC-PA Guide 4 (latest edition), "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," provides a description of accepted practices for retaining old sound coating, removing unsound coating, feathering, and spot cleaning.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-SP 8
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# SURFACE PREPARATION SPECIFICATION NO. 8

## Pickling

### 1. Scope

**1.1** This specification covers the requirements for the pickling of steel surfaces.

### 2. Definition

**2.1** Pickling is a method of preparing steel surfaces by chemical reaction, electrolysis, or both. The surfaces when viewed without magnification shall be free of all visible mill scale and rust.

### 3. Appearance of the Completed Surface

**3.1** The surface shall be etched to a degree suitable for the specified painting system.

**3.2** Uniformity of color may be affected by the grade, original surface condition, and configuration of the material being cleaned, as well as by discolorations from mill or fabrication marks, and the shadowing from etching patterns.

**3.3** Visual standards of surface preparation agreed upon by the contracting parties may be used to further define the surface.

### 4. Reference Standards

**4.1** The standards referenced in this specification are listed 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 SSPC SPECIFICATIONS:**

| | |
|---|---|
| **SP 1** | Solvent Cleaning |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 6** | Commercial Blast Cleaning |
| **SP 7** | Brush-Off Blast Cleaning |
| **SP 11** | Power Tool Cleaning to Bare Metal |

### 5. Pickling Methods and Operation

**5.1 BEFORE PICKLING, PERFORM THE FOLLOWING:**

**5.1.1** Remove heavy deposits of oil, grease, soil, drawing compounds, and foreign matter other than rust, scale, or oxide by any of the methods specified in SSPC-SP 1. Small quantities of such foreign matter may be removed in the pickling tanks provided no detrimental residue remains on the surface.

**5.1.2** Remove heavy deposits of rust, rust scale, and all paint by any one of the methods specified in SSPC-SP 2, SP 3, SP 6, SP 7, or SP 11. Rust deposits which can be removed without unduly prolonging the pickling time may be removed in the pickling tanks.

**5.2 REMOVE ALL MILL SCALE AND RUST BY ANY OF THE FOLLOWING PICKLING METHODS:**

**5.2.1** Pickling in hot or cold solutions of sulfuric, hydrochloric (muriatic), or phosphoric acid to which sufficient inhibitor has been added to minimize attack on the base metal, followed by adequate rinsing in hot water above 140 ˚F (60˚C).

**5.2.2** Pickling in 5%-10% (by weight) sulfuric acid, containing an inhibitor, at a minimum of 140˚F (60˚C) until all rust and scale is removed; then thorough rinsing in clean water, then immersion for one to five minutes in 1%-2% (by weight) phosphoric acid containing about 0.3%-0.5% iron phosphate, at a temperature of about 180˚F (82˚C).

**5.2.3** Pickling in 5% (by volume) sulfuric acid at 170-180˚F (77-82˚C), with sufficient inhibitor added to minimize attack on the base metal, until all rust and scale is removed, followed by a two minute rinse in hot water at 170-180˚F (77-82˚C). Next, immerse the pickled and rinsed steel for at least two minutes in a hot, inhibitive solution maintained above 190˚F (88˚C) and containing about 0.75% sodium dichromate and about 0.5% orthophosphoric acid.

**5.2.4** Electrolytic pickling in an acid or an alkaline bath using alternating or direct current. If (when using direct current) the work-piece is made the cathode, hydrogen embrittlement must be prevented or minimized by adequate treatment. If carried out in an alkaline bath, the electrolytic

Provided by : www.spic.ir Licensee: NISOC Library

pickling must be followed by a thorough rinse in hot water; then followed by a dip in a dilute solution of phosphoric acid, or chromic acid, or solution of dichromate until no trace of alkali remains on the surface.

**5.2.5** "Hydride" descaling, pickling in baths of acid salts, pickling in baths of molten salts, or pickling in any other manner than outlined in the preceding sections shall be permitted only when specified, since their details are beyond the scope of this specification.

**5.3** Do not exceed a dissolved iron content of 6% in sulfuric acid baths, or 10% in hydrochloric (muriatic) acid baths.

**5.4** Use only clean water or steam condensate for solutions and rinses. Supply rinse tanks continuously with new water. Do not permit the total amount of acid or dissolved salts due to carry-over to exceed two grams per liter (0.2% by weight).

**5.5** To minimize carry-over, suspend all steel briefly over the acid tank from which it has been withdrawn and permit the major portion of the acid to drain.

**5.6** Remove deleterious smut, unreacted acid or alkali, metal deposits, or other contaminants.

**5.7** Do not stack pickled steel surfaces in contact with one another until completely dry.

**5.8** Apply paint before visible rusting occurs.

## 6. Inspection

**6.1** 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 procedure specified by the American Arbitration Association shall be used.

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

## 7. Safety

**7.1** All safety requirements stated in this specification and its component parts apply in addition to any applicable federal, state, and local rules and requirements. They also shall be in accord with instructions and requirements of insurance underwriters.

## 8. Notes*

**8.1** While every precaution is taken to insure that all information furnished in SSPC specifications is as accurate, complete, and useful as possible, 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.

**8.2** A Commentary Section is available and contains additional information and data relevant to this specification. The Surface Preparation Commentary, SSPC-SP COM, is not part of this specification. The table below lists the subjects discussed relevant to pickling and appropriate Commentary Section.

| Subject | SSPC-SP COM Section |
|---|---|
| Film Thickness | 10 |
| Inhibitors | 8.3 |
| Rust Back | 4.5 |
| Weld Spatter | 4.4.1 |
| Visual Standards | 11 |

*Notes are not requirements of this specification.

Provided by : www.spic.ir Licensee: NISOC Library

## Joint Surface Preparation Standard

# SSPC-SP NO. 10/NACE NO. 2

## Near-White Blast Cleaning

This SSPC: The Society for Protective Coatings and NACE International standard represents a consensus of those individual members who have reviewed this document, its scope and provisions. Its acceptance does not in any respect preclude anyone, having adopted the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not in conformance with this standard. Nothing contained in this standard is to be construed as granting any right, by implication or otherwise, to manufacture, sell, or use in connection with any method, apparatus, or product covered by Letters Patent, or as indemnifying or protecting anyone against liability for infringement of Letters Patent. This standard represents minimum requirements and should in no way be interpreted as a restriction on the use of better procedures or materials. Neither is this standard intended to apply in all cases relating to the subject. Unpredictable circumstances may negate the usefulness of this standard in specific instances. SSPC and NACE assume no responsibility for the interpretation or use of this standard by other parties and accept responsibility for only those official interpretations issued by SSPC or NACE in accordance with their respective governing procedures and policies, which preclude the issuance of interpretations by individual volunteers.

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

CAUTIONARY NOTICE: SSPC/NACE standards are subject to periodic review and may be revised or withdrawn at any time without prior notice. SSPC and NACE require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of initial publication. The user is cautioned to obtain the latest edition. Purchasers may receive current information on all standards and other publications by contacting the organizations at the addresses below:

©NACE International
P.O. Box 218340
Houston, TX 77218-8340
(telephone +1 281/228-6200)

© SSPC: The Society for Protective Coatings
40 24th Street, Sixth Floor
Pittsburgh, PA 15222
(telephone +1 412/281-2331)

## Foreword

This joint standard covers the use of blast cleaning abrasives to achieve a defined degree of cleaning of steel surfaces prior to the application of a protective coating or lining system. This standard is intended for use by coating or lining specifiers, applicators, inspectors, or others whose responsibility it may be to define a standard degree of surface cleanliness.

The focus of this standard is near-white metal blast cleaning. White metal blast cleaning, commercial blast cleaning, industrial blast cleaning and brush-off blast cleaning are addressed in separate standards.

Near-white blast cleaning provides a greater degree of cleaning than commercial blast cleaning (SSPC-SP 6/NACE No. 3), but less than white metal blast cleaning (SSPC-SP 5/NACE No. 1).

Near-white blast cleaning is used when the objective is to remove all rust, coating, and mill scale, but when the extra effort required to remove all stains of these materials is determined to be unwarranted. Staining shall be limited to no more than 5 percent of each unit area of surface.

Near-white blast cleaning allows staining on only 5 percent of each unit area of surface, while commercial blast cleaning allows staining on 33 percent of each unit area of surface. White metal blast cleaning does not permit any staining to remain on the surface.

This joint standard was prepared by the SSPC/NACE Task Group A on Surface Preparation by Abrasive Blast Cleaning. This joint Task Group includes members of both the SSPC Surface Preparation Committee and the NACE Unit Committee T-6G on Surface Preparation.

Provided by : www.spic.ir Licensee: NISOC Library

## 1. General

**1.1** This joint standard covers the requirements for near-white blast cleaning of unpainted or painted steel surfaces by the use of abrasives. These requirements include the end condition of the surface and materials and procedures necessary to achieve and verify the end condition.

**1.2** This joint standard allows random staining to remain on no more than 5 percent of each unit area of surface as defined in Section 2.6.

**1.3** The mandatory requirements are described in Sections 1 to 9 as follows:

| | |
|---|---|
| Section 1 | General |
| Section 2 | Definition |
| Section 3 | References |
| Section 4 | Procedures Before Blast Cleaning |
| Section 5 | Blast Cleaning Methods and Operation |
| Section 6 | Blast Cleaning Abrasives |
| Section 7 | Procedures Following Blast Cleaning and Immediately Prior to Coating |
| Section 8 | Inspection |
| Section 9 | Safety and Environmental Requirements |

NOTE: Section 10, "Comments" and Appendix A, "Explanatory Notes" are not mandatory requirements of this standard.

## 2. Definition

**2.1** A near-white metal blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter, except for staining as noted in Section 2.2.

**2.2** Random staining shall be limited to no more than 5 percent of each unit area of surface as defined in Section 2.6, and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coating.

**2.3** Acceptable variations in appearance that do not affect surface cleanliness as defined in Section 2.1 include variations caused by type of steel, original surface condition, thickness of the steel, weld metal, mill or fabrication marks, heat treating, heat affected zones, blasting abrasives, and differences in the blast pattern.

**2.4** When a coating is specified, the surface shall be roughened to a degree suitable for the specified coating system.

**2.5** Immediately prior to coating application, the entire surface shall comply with the degree of cleaning specified herein.

**2.6** Unit area for determinations shall be approximately 5776 $mm^2$ (9 $in^2$) (i.e., a square 76 mm x 76 mm [3 in x 3 in]).

**2.7** SSPC-VIS 1-89, photographs A SP-10, B SP-10, C SP-10 or D SP-10 may be specified to supplement the written definition. In any dispute, the written standards shall take precedence over visual standards and comparators. Additional information on visual standards and comparators is available in Section A.4 of Appendix A.

## 3. References

**3.1** The documents referenced in this standard are listed in Section 3.4.

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

**3.3** If there is a conflict between the requirements of any of the cited reference standards and this standard, the requirements of this standard shall prevail.

**3.4 SSPC: THE SOCIETY FOR PROTECTIVE COATINGS STANDARDS:**

| | |
|---|---|
| **AB 1** | Mineral and Slag Abrasives |
| **AB 2** | Cleanliness of Recycled Ferrous Metallic Abrasives |
| **AB 3** | Newly Manufactured or Re-Manufactured Steel Abrasive |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **SP 1** | Solvent Cleaning |
| **VIS 1** | Visual Standard for Abrasive Blast Cleaned Steel |

## 4. Procedures Before Blast Cleaning

**4.1** Before blast cleaning, visible deposits of oil, grease, or other contaminants shall be removed in accordance with SSPC-SP 1 or other agreed upon methods.

**4.2** Before blast cleaning, surface imperfections such as sharp fins, sharp edges, weld spatter, or burning slag should be removed from the surface to the extent required by the procurement documents (project specification). Additional information on surface imperfections is available in Section A.5 of Appendix A.

**4.3** If a visual standard or comparator is specified to supplement the written standard, the condition of the steel prior to blast cleaning should be determined before the blasting commences. Additional information on visual standards and comparators is available in Section A.4 of Appendix A.

Provided by : www.spic.ir Licensee: NISOC Library

## 5. Blast Cleaning Methods and Operation

**5.1** Clean, dry compressed air shall be used for nozzle blasting. Moisture separators, oil separators, traps, or other equipment may be necessary to achieve this requirement.

**5.2** Any of the following methods of surface preparation may be used to achieve a near-white blast cleaned surface:

**5.2.1** Dry abrasive blasting using compressed air, blast nozzles, and abrasive.

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

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

**5.3** Other methods of surface preparation (such as wet abrasive blasting) may be used to achieve a near-white blast cleaned surface by mutual agreement between those parties responsible for establishing the requirements and those responsible for performing the work. NOTE: Information on the use of inhibitors to prevent the formation of rust immediately after wet blast cleaning is contained in Section A.9 of Appendix A.

## 6. Blast Cleaning Abrasives

**6.1** The selection of abrasive size and type shall be based on the type, grade, and surface condition of the steel to be cleaned, type of blast cleaning system employed, the finished surface to be produced (cleanliness and roughness), and whether the abrasive will be recycled.

**6.2** The cleanliness and size of recycled abrasives shall be maintained to ensure compliance with this specification.

**6.3** The blast cleaning abrasive shall be dry and free of oil, grease, and other contaminants as determined by the test methods found in SSPC-AB 1, AB 2 and AB 3.

**6.4** Any limitations on the use of specific abrasives, the quantity of contaminants, or the degree of allowable embedment shall be included in the procurement documents (project specification) covering the work, because abrasive embedment and abrasives containing contaminants may not be acceptable for some service requirements. NOTE: Additional information on abrasive selection is given in Section A.2 of Appendix A.

## 7. Procedures Following Blast Cleaning and Immediately Prior to Coating

**7.1** Visible deposits of oil, grease, or other contaminants shall be removed according to SSPC-SP 1 or another method agreed upon by those parties responsible for establishing the requirements and those responsible for performing the work.

**7.2** Dust and loose residues shall be removed from prepared surfaces by brushing, blowing off with clean, dry air, vacuum cleaning, or other methods agreed upon by those responsible for establishing the requirements and those responsible for performing the work. NOTE: The presence of toxic metals in the abrasives or paint being removed may place restrictions on the methods of cleaning permitted. Comply with all applicable regulations. Moisture separators, oil separators, traps, or other equipment may be necessary to achieve clean, dry air.

**7.3** After blast cleaning, surface imperfections that remain (e.g., sharp fins, sharp edges, weld spatter, burning slag, scabs, slivers, etc.) shall be removed to the extent required in the procurement documents (project specification). Any damage to the surface profile resulting from the removal of surface imperfections shall be corrected to meet the requirements of Section 2.4. NOTE: Additional information on surface imperfections is contained in Section A.5 of Appendix A.

**7.4** Any visible rust that forms on the surface of the steel after blast cleaning shall be removed by recleaning the rusted areas to meet the requirements of this standard before coating. NOTE: Information on rust-back (re-rusting) and surface condensation is contained in Sections A.6, A.7 and A.8 of Appendix A.

## 8. Inspection

**8.1** Work and materials supplied under this standard are subject to inspection by a representative of those responsible for establishing the requirements. Materials and work areas shall be accessible to the inspector. The procedures and times of inspection shall be as agreed upon by those responsible for establishing the requirements and those responsible for performing the work.

**8.2** Conditions not complying with this standard shall be corrected. In the case of a dispute, an arbitration or settlement procedure established in the procurement documents (project specification) shall be followed. If no arbitration or settlement procedure is established, then a procedure mutually agreeable to purchaser and supplier shall be used.

Provided by : www.spic.ir Licensee: NISOC Library

**8.3** The procurement documents (project specification) should establish the responsibility for inspection and for any required affidavit certifying compliance with the specification.

## 9. Safety and Environmental Requirements

**9.1** Because abrasive blast cleaning is a hazardous operation, all work shall be conducted in compliance with applicable occupational and environmental health and safety rules and regulations. NOTE: SSPC-PA Guide 3, "A Guide to Safety in Paint Application," addresses safety concerns for coating work.

## 10. Comments

**10.1** Additional information and data relative to this standard are contained in Appendix A. Detailed information and data are presented in a separate document, SSPC-SP COM, "Surface Preparation Commentary." The recommendations contained in Appendix A and SSPC-SP COM are believed to represent good practice, but are not to be considered requirements of the standard. The sections of SSPC-SP COM that discuss subjects related to near-white blast cleaning are listed below.

| Subject | Commentary Section |
|---|---|
| Abrasive Selection | 6 |
| Film Thickness | 10 |
| Wet Abrasive Blast Cleaning | 8.2 |
| Maintenance Repainting | 4.2 |
| Rust-back (Re-rusting) | 8.3 |
| Surface Profile | 6.2 |
| Visual Standards | 11 |
| Weld Spatter | 4.4.1 |

## Appendix A. Explanatory Notes

**A.1 FUNCTION:** Near-white blast cleaning (SSPC-SP 10/NACE No. 2) provides a greater degree of cleaning than commercial blast cleaning (SSPC-SP 6/NACE No. 3) but less than white metal blast cleaning (SSPC-SP 5/NACE No. 1). It should be used when a high degree of blast cleaning is required. The primary functions of blast cleaning before coating are: (a) to remove material from the surface that can cause early failure of the coating system and (b) to obtain a suitable surface roughness and to enhance the adhesion of the new coating system. The hierarchy of blasting standards is as follows: white metal blast cleaning, near-white blast cleaning, commercial blast cleaning, industrial blast cleaning, and brush-off blast cleaning.

**A.2 ABRASIVE SELECTION:** Types of metallic and non-metallic abrasives are discussed in the Surface Preparation Commentary (SSPC-SP COM). It is important to recognize that blasting abrasives may become embedded in or leave residues on the surface of the steel during preparation. While normally such embedment or residues are not detrimental, care should be taken to ensure that the abrasive is free from detrimental amounts of water-soluble, solvent-soluble, acid-soluble, or other soluble contaminants (particularly if the prepared steel is to be used in an immersion environment). Criteria for selecting and evaluating abrasives are given in SSPC-AB 1, "Mineral and Slag Abrasives," SSPC-AB 2, "Cleanliness of Recycled Ferrous Metallic Abrasives," and SSPC-AB 3, "Newly Manufactured or Re-Manufactured Steel Abrasives."

**A.3 SURFACE PROFILE:** Surface profile is the roughness of the surface which results from abrasive blast cleaning. The profile depth (or height) is dependent upon the size, shape, type, and hardness of the abrasive, particle velocity and angle of impact, hardness of the surface, amount of recycling, and the proper maintenance of working mixtures of grit and/or shot.

The allowable minimum/maximum height of profile is usually dependent upon the thickness of the coating to be applied. Large particle sized abrasives (particularly metallic) can produce a profile that may be too deep to be adequately covered by a single thin film coat. Accordingly, it is recommended that the use of larger abrasives be avoided in these cases. However, larger abrasives may be needed for thick film coatings or to facilitate removal of thick coatings, heavy mill scale, or rust. If control of profile (minimum/maximum) is deemed to be significant to coating performance, it should be addressed in the procurement documents (project specification). Typical profile heights achieved with commercial abrasive media are shown in Table 5 of the Surface Preparation Commentary (SSPC-SP COM). Surface profile should be measured in accordance with NACE Standard RP0287 (latest edition), "Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using Replica Tape," or ASTM[1] D 4417 (latest edition), "Test Method for Field Measurement of Surface Profile of Blast Cleaned Steel."

**A.4 VISUAL STANDARDS:** SSPC-VIS 1-89 (Visual Standard for Abrasive Blast Cleaned Steel) provides color photographs for the various grades of surface preparation as a function of the initial condition of the steel. The series A-SP 10, B-SP 10, C-SP 10 and D-SP 10 photographs depict surfaces cleaned to a near-white blast grade. Other available visual standards are described in Section 11 of SSPC-SP COM.

**A.5 SURFACE IMPERFECTIONS:** Surface imperfections can cause premature failure when the service is severe. Coatings tend to pull away from sharp edges and

[1] ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

Provided by : www.spic.ir Licensee: NISOC Library

projections, leaving little or no coating to protect the underlying steel. Other features that are difficult to properly cover and protect include crevices, weld porosities, laminations, etc. The high cost of the methods to remedy 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 blast cleaning operation. Other surface defects (steel laminations, weld porosities, or deep corrosion pits) may not be evident until the surface preparation has been completed. Therefore, proper planning for such surface repair work is essential because the timing of the repairs may occur before, during, or after the blast cleaning operation. Section 4.4 of SSPC-SP COM and NACE Standard RP0178 (latest edition), "Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service" contain additional information on surface imperfections.

**A.6 CHEMICAL CONTAMINATION:** Steel contaminated with soluble salts (e.g., chlorides and sulfates) develops rust-back rapidly at intermediate and high humidities. These soluble salts can be present on the steel surface prior to blast cleaning as a result of atmospheric contamination. In addition, contaminants can be deposited on the steel surface during blast cleaning if the abrasive is contaminated. Therefore, rust-back can be minimized by removing these salts from the steel surface,, and eliminating sources of recontamination during and after blast cleaning. Wet methods of removal are described in SSPC-SP 12/NACE No. 5. Identification of the contaminants along with their concentrations may be obtained from laboratory and field tests as described in SSPC-TU 4, "Technology Update on Field Methods for Retrieval and Analysis of Soluble Salts on Substrates."

**A.7 RUST-BACK:** Rust-back (re-rusting) occurs when freshly cleaned steel is exposed to moisture, contamination, or a corrosive atmosphere. The time interval between blast cleaning and rust-back will vary greatly from one environment to another. Under mild ambient conditions, if chemical contamination is not present (see Section A.6), it is best to blast clean and coat a surface the same day. Severe conditions may require more expedient coating application to avoid contamination from fallout. Chemical contamination should be removed prior to coating (see Section A.6).

**A.8 DEW POINT:** Moisture condenses on any surface that is colder than the dew point of the surrounding air. It is, therefore, recommended that the temperature of the steel surface be at least 3 °C (5 °F) above the dew point during dry blast cleaning operations. It is advisable to visually inspect for moisture and periodically check the surface temperature and dew point during blast cleaning operations and to avoid the application of coating over a damp surface.

**A.9 WET ABRASIVE BLAST CLEANING:** Steel that is wet abrasive blast cleaned may rust rapidly. Clean water should be used for rinsing. It may be necessary that inhibitors be added to the water or applied to the surface immediately after blast cleaning to temporarily prevent rust formation. The use of inhibitors or the application of coating over slight discoloration should be in accordance with the requirements of the coating manufacturer. CAUTION: Some inhibitive treatments may interfere with the performance of certain coating systems.

**A.10 FILM THICKNESS:** It is essential that ample coating be applied after blast cleaning to adequately cover the peaks of the surface profile. The dry film thickness of the coating above the peaks of the profile should equal the thickness known to be needed for the desired protection. If the dry film thickness over the peaks is inadequate, premature rust-through or failure will occur. To assure that coating thicknesses are properly measured the procedures in SSPC-PA 2 (latest edition), "Measurement of Dry Coating Thickness with Magnetic Gauges" should be used.

**A.11 MAINTENANCE AND REPAIR PAINTING:** When this standard is used in maintenance painting, specific instructions should be given on the extent of surface to be blast cleaned or spot blast cleaned to this degree of cleanliness. In these cases, the cleaning shall be performed across the entire area specified. For example, if all weld seams are to be cleaned in a maintenance operation, this degree of cleaning shall be applied 100% to all weld seams. If the entire structure is to be prepared, this degree of cleaning shall be applied to 100% of the entire structure. SSPC-PA Guide 4 (latest edition), "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," provides a description of accepted practices for retaining old sound coating, removing unsound coating, feathering, and spot cleaning.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# SURFACE PREPARATION SPECIFICATION NO. 11

## Power Tool Cleaning to Bare Metal

### 1. Scope

**1.1** This specification covers the requirements for power tool cleaning to produce a bare metal surface and to retain or produce a surface profile.

**1.2** This specification is suitable where a roughened, clean, bare metal surface is required, but where abrasive blasting is not feasible or permissible.

**1.3** This specification differs from SSPC-SP 3, Power Tool Cleaning, in that SSPC-SP 3 requires only the removal of loosely adherent materials and does not require producing or retaining a surface profile.

### 2. Definition

**2.1** Metallic surfaces which are prepared according to this specification, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of pits if the original surface is pitted.

**2.2** When painting is specified, the surface shall be roughened to a degree suitable for the specified paint system. The surface profile shall not be less than 1 mil (25 micrometers). NOTE: Additional information on profile is contained in Sections A.5 and A.6 of the Appendix.

**2.3** Photographs or other visual standards may be used to supplement the written definition. NOTE: Additional information on visual standards is available in Section A.7 of the Appendix.

### 3. Power Surface Preparation Tools and Media

**3.1 SURFACE CLEANING POWER TOOLS:** Any tool capable of appropriately driving the media of Section 3.3 is acceptable; the surface profile may or may not be destroyed.

**3.2 IMPACT AND OTHER PROFILE PRODUCING POWER TOOLS:** Any tool on which the media of Section 3.4 can be properly mounted and used to produce the required uniform profile is acceptable. NOTE: Information on suitable tools is found in Sections A.3.a and A.3.b of the Appendix.

**3.3 SURFACE CLEANING MEDIA:**

**3.3.1** Non-woven abrasive wheels and discs constructed of a non-woven synthetic fiber web material of continuous undulated filaments impregnated with an abrasive grit. NOTE: Information on suitable discs and wheels is found in Section A.3.c of the Appendix.

**3.3.2** Coated abrasive discs (sanding pads), coated abrasive flap wheels, coated abrasive bands or other coated abrasive devices capable of running on power tools. NOTE: Information on suitable wheels is found in Section A.3.d of the Appendix.

**3.3.3** Other materials that produce the requirements of Section 2.1.

**3.4 SURFACE PROFILE PRODUCING MEDIA:**

**3.4.1** Rotary impact flap assembly consisting of a flexible loop construction with carbide spheres bonded to the peening surfaces of each of the metal supports fastened to the loop. NOTE: Information on suitable flap assemblies is found in Section A.3.e of the Appendix.

**3.4.2** Needle guns consisting of a bundle of wire “needles” which can impact a surface, producing a peened effect. NOTE: Information on suitable needles is found in Section A.3.f of the Appendix.

**3.4.3** Other materials which, when mounted on power hand tools, can produce the profile required in Section 2.2.

### 4. Reference Standards

**4.1** The standards referenced in this specification are listed in Section 4.4 and form a part of this specification.

**4.2** The latest issue, revision, or amendment of the referenced 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 this specification, the requirements of this specification shall prevail.

**4.4 SSPC SPECIFICATIONS:**

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **SP 1** | Solvent Cleaning |
| **SP 3** | Power Tool Cleaning |
| **VIS 3** | Visual Standard for Power- and Hand-Tool Cleaned Steel |

## 5. Procedures Prior to Power Tool Surface Preparation

**5.1** Prior to power tool surface preparation, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP 1, "Solvent Cleaning," or other agreed-upon methods.

**5.2** Prior to power tool surface preparation, remove surface imperfections such as sharp fins, sharp edges, weld spatter, or burning slag to the extent required by the procurement documents (project specification). NOTE: Additional information on surface imperfections is available in Appendix A.9.

## 6. Power Tool Surface Preparation Methods and Operations

**6.1** Depending on profile conditions, use either or both of the following methods to remove tightly adhering materials and to retain or produce the required surface profile with power tools:

**6.1.1 Profile Condition A, Acceptable Profile Exists:** Achieve the cleanliness required in Section 2.1 by using power tools described in Section 3.1.

**6.1.2 Profile Condition B. Unacceptable Profile Exists:** Achieve the cleanliness required in Section 2.1 and the profile required in Section 2.2 by using power tools described in Section 3. NOTE: Information on the selection of tools and cleaning media is found in Section A.2 of the Appendix.

## 7. Procedures Following Power Tool Surface Preparation

**7.1** After power tool surface preparation and prior to the application of coatings, reclean the surface if it does not conform to this specification.

**7.2** Remove visible deposits of oil, grease, or other contaminants by any of the methods specified in SSPC-SP 1 or other methods agreed upon by the party responsible for establishing the requirements and the party responsible for performing the work. NOTE: Information on oil contamination is found in Section A.4.d of the Appendix.

**7.3** Remove dirt, dust, or similar contaminants from the surface. Acceptable methods include brushing, blow off with oil-free, clean, dry air; vacuum cleaning; or wiping with a clean, dry cloth.

**7.4** Power tool prepared surfaces must be coated prior to the reformation of rust or visible contamination.

## 8. Inspection

**8.1** Surfaces prepared under this specification shall be subject to timely inspection by the purchaser or his authorized representative. The contractor shall correct such work as is found defective under this specification. In case of dispute, the arbitration or settlement procedure as established in the procurement documents (project specification), shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**8.2** The procurement documents (project specification) covering work or purchase shall establish the responsibility for testing and for any required affidavit certifying full compliance with the specification.

## 9. Safety

**9.1** All safety requirements stated in the procurement document as well as this specification and its component parts apply in addition to any applicable federal, state, and local rules and requirements. They also shall be in accord with instructions and requirements of insurance underwriters.

## 10. Comments

**10.1** While every precaution is taken to insure that all information furnished in SSPC specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, paints, or methods specified therein, or of the specification itself.

**10.2** Additional information and data relative to this specification are contained in the following Appendix. Additional detailed information and data are presented in a separate document, SSPC-SP COM, "Surface Preparation Commentary." The recommendations contained in the Notes, Appendix, and SSPC-SP COM are believed to represent good practice, but are not to be considered as requirements of the specification. The table below lists the appropriate section of SSPC-SP COM.

| Subject | Commentary Section |
|---|---|
| Film Thickness | 10 |
| Maintenance Painting | 4.2 |
| Rust-Back (Rerusting) | 4.5 |
| Visual Standards | 11 |

Provided by : www.spic.ir Licensee: NISOC Library

Weld Spatter ..... 4.4.1

## A. Appendix

**A.1 FUNCTION:** Power tool surface preparation to remove tightly adherent material produces a surface which is visibly free from all rust, mill scale, and old coatings and which has a surface profile. It produces a greater degree of cleaning than SSPC-SP 3, "Power Tool Cleaning," (which does not remove tightly adherent material) and may be considered for coatings requiring a bare metal substrate.

The surfaces prepared according to this specification are not to be compared to surfaces cleaned by abrasive blasting. Although this method produces surfaces that "look" like "near-white" or "commercial blast," they are not necessarily equivalent to those surfaces produced by abrasive blast cleaning as called for in SSPC-SP 10 or SP 6.

**A.2 SELECTION OF TOOLS AND CLEANING MEDIA:** Selection of power tools and cleaning media shall be based on (1) the condition of the surface prior to surface preparation, (2) the extent of cleaning that is required to remove rust, scale and other matter from the surface and (3) the type of surface profile required.

**A.2.1 Selection of Media:** If an acceptable surface profile existed prior to preparing the surface, cleaning media, such as found in Section 3.3, shall be selected that will remove surface contaminants without severely reducing or removing the profile, if possible. If the surface profile is removed or severely reduced when preparing the surface, or if there was no profile prior to surface preparation, surface profiling media, such as found in Section 3.4, shall be selected that will produce an acceptable surface profile as required by this specification. When power tool cleaning rusted surfaces it is important to avoid embedding or peening rust into the substrate. This may require removal of rust prior to use of surface profiling media. These factors may require employing more than one type of medium in order to obtain the desired end result. NOTE: Power wire brushes when used alone will not produce the required surface profile and may remove or degrade an existing profile to an unacceptable level.

**A.2.2 Selection of Tools:** Power tools shall be selected on the basis of the size and speed rating of the media. These requirements may differ from one type of media to another and shall be taken into consideration when more than one type of medium will be used in the surface preparation process. Power tools shall be selected that will produce enough power to perform the cleaning operation efficiently. Operator fatigue shall be considered in the selection of power tools.

Further information on the selection of power tools and media is contained in Chapter 2.6, "Hand and Power Tool Cleaning," of SSPC Painting Manual, Volume 1, "Good Painting Practice."

**A.3 SUITABLE TOOLS AND MEDIA:** The text of this specification makes reference to the following footnotes. Inclusion of these items in this appendix is intended solely to guide the user to typical types of equipment and media which are available to meet the specification. The items mentioned are not all of the tools or products available, nor does their mention constitute an endorsement by SSPC.

a. The "Mini-Flushplate" from Desco Manufacturing Company, Inc., Long Beach, California, has been found suitable as a tool system which meets the requirements of this section.

b. The Aro Corporation, Bryan, Ohio, and VON ARX Air Tools Company, Englewood, New Jersey, are suppliers of needle gun equipment.

c. 3M Scotch-Brite Clean 'n Strip discs and wheels are able to satisfy the requirements.

d. Grind-O-Flex wheels from Merit Corporation, Compton, California and Nu-Matic air inflated wheels from NuMatic, Euclid, Ohio, have been found suitable.

e. 3M Heavy-Duty Roto-Peen flap assembly has been found suitable.

f. Needles having a diameter of 2 mm have been found to produce a surface profile suitable for many painting systems.

**A.4 OPERATION OF TOOLS:** The tools shall be operated in accordance with the manufacturers' instructions. In particular, note the following:

a. Observe the recommended operating speed (ROS). The maximum operating speed (MOS) does not necessarily give the most efficient cleaning.

b. The "rpm" (rotational speed) rating of some power tools and the cleaning media may not be compatible and could result in physical injury to the operator.

c. Exercise caution when power tools are used at critical structures (e.g., pressure vessel boundaries) so that excessive base metal is not removed.

d. When air driven tools are used, the exhaust could contain oil or moisture that could easily contaminate the recently prepared surface.

e. The media used on power tools have a finite life. When they do not produce the specified profile they shall be replaced.

Provided by : www.spic.ir Licensee: NISOC Library

Additional information on the operation of tools can be found in Chapter 2.6 of Volume 1, "Good Painting Practice" of SSPC Painting Manual.

**A.5 PROFILE:** The type of power tools to be used depends upon whether or not an acceptable profile exists on the surface to be cleaned.

Some limitations of the various types of media to produce a specific profile or to preserve an existing profile are as follows:

- Media of Section 3.3 produce a profile of approximately one-half mil (10-15 micrometers), whereas the media of Section 3.4 may produce a profile of 1 mil (25 micrometers) or more. The profile depends on the abrasive embedded in the rotary flaps or the diameter of the needles.
- Impact tools may produce sharp edges or cut into the base metal if not used properly.
- It is important to determine whether the profile requirements for the specified coating system can be met by this power tool cleaning method of surface preparation.

**A.6 MEASUREMENT OF SURFACE PROFILE:** Surface profile comparators and other visual or tactile gages used for abrasive blast cleaning are not suitable for measuring profile produced by power tools because of the differences in appearance. One acceptable procedure is use of coarse or extra coarse replica tape, as described in Method C of ASTM D 4417, "Field Measurement of Surface Profile of Blast Cleaned Steel." Replica tapes are valid for profiles in the ranges of 0.8 to 1.5 mils (20 to 38 micrometers) (coarse) to 1.5-4.5 mils (38-114 micrometers) (extra-coarse). (Note: Because of the limitations in compressibility of the mylar film, however, even very smooth surfaces will give readings of 0.5 mils [13 micrometers] or greater using the replica tape.)

**A.7 VISUAL STANDARDS:** Note that the use of visual standards in conjunction with this specification is required only when they are specified in the procurement documents (project specification) covering the work. It is recommended, however, that the use of visual standards be made mandatory in the procurement documents.

SSPC-VIS 3, "Visual Standard for Power- and Hand-Tool Cleaned Steel," provides color photographs for the various grades of surface preparation as a function of the initial condition of the steel. For more information about visual standards, see SSPC-SP COM, Section 11.

**A.8 INACCESSIBLE AREAS:** Because of the shape and configuration of the power tools themselves, some areas of a structure may be inaccessible for cleaning. These areas include surfaces close to bolt heads, inside corners, and areas with limited clearance. Areas which are inaccessible by this method of surface preparation shall be cleaned using an alternate method of surface preparation which may result in a different degree of surface cleanliness and surface profile. The alternate method shall be mutually agreed upon before commencing work.

**A.9 SURFACE IMPERFECTIONS:** Surface imperfections can cause premature failure when the environment 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. The high cost of methods to remedy the surface imperfections requires weighing the benefits of edge rounding, weld spatter removal, etc., versus a potential coating failure.

Poorly adherent contaminants, such as weld slag residues, loose weld spatter, and some minor surface laminations, must be removed during the power tool cleaning operation. Other surface defects (steel laminations, weld porosities, or deep corrosion pits) may not be evident until the surface preparation has been completed. Therefore, proper planning for such repair work is essential, since the timing of the repairs may occur before, during, or after the cleaning operation. Section 4.4 of the "Surface Preparation Commentary" (SSPC-SP COM) contains additional information on surface imperfections.

**A.10 CHEMICAL CONTAMINATION:** Steel contaminated with soluble salts (i.e., chlorides and sulfates) develops rustback rapidly at intermediate and high humidities. These soluble salts can be present on the steel surface prior to cleaning as a result of atmospheric contamination. In addition, contaminants can be deposited on the steel surface during cleaning whenever the media is contaminated. Therefore, rust-back can be minimized by removing these salts from the steel surface, preferably before power tool cleaning, and eliminating sources of recontamination during and after power tool cleaning. Identification of the contaminants along with their concentrations may be obtained from laboratory or field tests.

**A.11 RUST-BACK:** Rust-back (rerusting) occurs when freshly cleaned steel is exposed to conditions of high humidity, moisture, contamination, or a corrosive atmosphere. The time interval between power tool cleaning and rust-back will vary greatly from one environment to another. Under mild ambient conditions, it is best to clean and coat a surface the same day. Severe conditions may require coating more quickly, while for exposure under controlled conditions the coating time may be extended. Under no circumstances shall the steel be permitted to rust-back before painting regardless of time elapsed (see Section A. 10).

**A.12 DEW POINT:** Moisture condenses on any surface that is colder than the dew point of the surrounding air. It is,

Provided by : www.spic.ir Licensee: NISOC Library

therefore, recommended that the temperature of the steel surface be at least 5 ˚F (3 ˚C) above the dew point during power tool cleaning operations. It is advisable to visually inspect for moisture and periodically check the surface temperature and dew point during cleaning operations. It is important that the application of a coating over a damp surface be avoided.

**A.13 FILM THICKNESS:** It is essential that ample coating be applied after power tool cleaning to adequately cover the peaks of the surface profile. The dry film thickness above the peaks of the profile shall equal the thickness known to be needed for the desired protection. If the dry film thickness over the peaks is inadequate, premature rust-through or failure will occur. To assure that coating thicknesses are properly measured, refer to SSPC-PA 2, "Measurement of Dry Paint Thickness with Magnetic Gages."

**A.14 MAINTENANCE AND REPAIR PAINTING:** When this specification is used in maintenance painting, specific instructions shall be given on the extent of surface to be power tool cleaned or spot cleaned. SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," provides a description of accepted practices for retaining old sound paint, removing unsound paint, feathering, and spot cleaning.

Provided by : www.spic.ir Licensee: NISOC Library

# Joint Surface Preparation Standard

# SSPC-SP 12/NACE No. 5

# Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating

This SSPC: The Society for Protective Coatings/NACE International (NACE) standard represents a consensus of those individual members who have reviewed this document, its scope, and provisions. It is intended to aid the manufacturer, the consumer, and the general public. Its acceptance does not in any respect preclude anyone, whether he has adopted the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not addressed in this standard. Nothing contained in this SSPC/NACE standard is to be construed as granting any right, by implication or otherwise, to manufacture, sell, or use in connection with any method, apparatus, or product covered by Letters Patent, or as indemnifying or protecting anyone against liability for infringement of Letters Patent. This standard represents current technology and should in no way be interpreted as a restriction on the use of better procedures or materials. Neither is this standard intended to apply in all cases relating to the subject. Unpredictable circumstances may negate the usefulness of this standard in specific instances. NACE and SSPC assume no responsibility for the interpretation or use of this standard by other parties and accept responsibility for only those official interpretations issued by NACE or SSPC in accordance with their governing procedures and policies which preclude the issuance of interpretations by individual volunteers.

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

CAUTIONARY NOTICE: SSPC/NACE standards are subject to periodic review, and may be revised or withdrawn at any time without prior notice. The user is cautioned to obtain the latest edition. NACE and SSPC require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of initial publication.

©1995

SSPC: The Society for Protective Coatings
40 24th St.
Pittsburgh, Pennsylvania 15222
+1 412/281-2331

NACE International
P.O. Box 218340
Houston, Texas 77218-8340
+1 713/492-0535

Provided by : www.spic.ir Licensee: NISOC Library

## Foreword

Since publication of NACE Standard RP0172, "Surface Preparation of Steel and Other Hard Materials by Water Blasting Prior to Coating or Recoating," surface preparation using water jetting equipment has found acceptance as a viable method. The coatings industry, under the influence of government regulations, is working to find environmentally sensitive and user-friendly methods of surface preparation. The use of a high-energy water stream to strip existing coatings and for surface cleaning has advantages over dry abrasive blasting with respect to worker respiratory exposure and work area air quality. Respiratory requirements for water jetting may be less stringent than for other methods of surface preparation.

Abrasive blasting, one of the most common surface preparation techniques, is sometimes not feasible or desirable because the resultant flying abrasive particles and drifting dust may damage highly sensitive rotary equipment and filters, cause contamination of nearby mechanical equipment and structures, or cause contamination of the environment. Abrasive blasting may also trap contaminants within the topography. This standard describes the surface preparation technique known as water jetting, which provides an alternative method of removing coating systems, including lead-based paint systems. Water jetting is effective in removing (1) deleterious amounts of water-soluble surface contaminants that may not otherwise be removed by dry abrasive blasting alone, specifically in the bottom of pits and craters of severely corroded metallic substrates; (2) surface grease and oil; (3) rust; (4) shot-creting spatter; and (5) existing coatings and linings. Cold working of the topography of the surface does not occur in water jetting. Because water jetting does not provide the primary anchor pattern known to the coatings industry, this standard recommends its use primarily for recoating or relining projects where there is an adequate preexisting profile.

This standard addresses degrees of cleanliness, types of equipment, operating procedures, and safety factors associated with water jetting. Although this standard discusses jetting pressures up to 250 MPa[1] (36,000 psi), higher pressures may be used as technology and equipment evolve. High-pressure water jetting has application in a broad spectrum of industry; however, its use as described in this standard is particularly suited to the process industry, power plants, and other industrial plants where the use of high-performance coatings requires extensive surface preparation and/or surface decontamination.

This standard was prepared by NACE/SSPC Joint Task Group D on Surface Preparation by High-Pressure Water Jetting and is issued by NACE International under the auspices of NACE Group Committee T-6 on Protective Coatings and Linings and by the SSPC. This standard replaces NACE Standard RP0172, "Surface Preparation of Steel and Other Hard Materials by Water Blasting Prior to Coating or Recoating," and addresses current technology and equipment for high-pressure water cleaning, including water jetting.

Provided by : www.spic.ir Licensee: NISOC Library

[1] 1 MPa = 10 bar

# Joint Surface Preparation Standard SSPC-SP 12/NACE No. 5

# Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating

**Contents**

1. General
2. Definitions
3. Surface Cleanliness Conditions
4. Safety
5. Cautionary Notes

Bibliography

Appendix A—Commentary on Production Rates
Appendix B—Procedures for Extracting and Analyzing Soluble Salts
Appendix C—Water Jetting Equipment
Appendix D—Operating Procedures
Appendix E—Efficiency of Water Jetting at Various Pressure Ratings
Appendix F—Principles of Water Jetting
Appendix G—Reported Case Histories on Production Rates

Provided by : www.spic.ir Licensee: NISOC Library

## Section 1: General

1.1 This standard provides requirements for the use of high- and ultrahigh-pressure water jetting to achieve various degrees of surface cleanliness. This standard is limited in scope to the use of water only without the addition of solid particles in the stream.

1.2 Information on water jetting equipment, production rates, procedures, and principles is available in the appendices. Appendices A, B, C, D, E, F, and G do not provide requirements but give additional information on water jetting that will be useful to the owner, user, or contractor.

## Section 2: Definitions

2.1 This section provides basic water jetting definitions. Additional definitions relevant to water jetting are contained in "Recommended Practices for the Use of Manually Operated High-Pressure Water Jetting Equipment."[2]

2.1.1 **Water Jetting (WJ)**: Water jetting is the use of standard jetting water at high or ultrahigh pressure to prepare a surface for recoating using pressures above 70 MPa (10,000 psi). Water jetting will not produce an etch or profile of the magnitude currently recognized by the surface preparation industry; rather, it exposes the original abrasive-blasted surface profile.

2.1.2 **Standard Jetting Water**: Standard jetting water is water of sufficient purity and quality that it does not impose additional contaminants on the surface being cleaned and, of critical importance to water jetting operations, does not contain sediments or other impurities that are destructive to the proper functioning of the water jetting equipment being used.

2.1.3 **Low-Pressure Water Cleaning (LP WC)**: LP WC is cleaning performed at pressures less than 34 MPa (5,000 psi).

2.1.4 **High-Pressure Water Cleaning (HP WC)**: HP WC is cleaning performed at pressures from 34 to 70 MPa (5,000 to 10,000 psi).

2.1.5 **High-Pressure Water Jetting (HP WJ)**: HP WJ is cleaning performed at pressures from 70 to 170 MPa (10,000 to 25,000 psi).

2.1.6 **Ultrahigh-Pressure Water Jetting (UHP WJ)**: UHP WJ is cleaning performed at pressures above 170 MPa (25,000 psi).

2.1.7 **Surface Cleanliness (SC)**: Surface cleanliness is the condition of the substrate after water jetting has removed partial or total residues of chloride, soluble ferrous salts, and sulfate contaminants.

## Section 3: Surface Cleanliness Conditions

3.1 Table 1 lists four conditions of surface cleanliness in terms of **visible** contaminants. A surface shall be prepared to one of these four visual conditions prior to recoating. As part of the surface preparation, deposits of oil, grease, and foreign matter must be removed by ultrahigh-pressure water jetting, by steam cleaning with detergent, by methods in accordance with SSPC-SP 1[3] or by another method agreed upon by all parties to the contract. NOTE: Direct correlation to existing dry media blasting standards is inaccurate or inappropriate when describing the capabilities of water jetting and the results achieved by water jetting.

3.2 Table 2 lists three surface preparation conditions in terms of **nonvisible** chemical contaminants. In addition to the requirement given in Paragraph 3.1, a surface shall be prepared to one of these three nonvisual conditions prior to recoating, when deemed necessary.

[2] U.S. Water Jet Technology Association, "Recommended Practices for the Use of Manually Operated High-Pressure Water Jetting Equipment" (St. Louis, MO: U.S. Water Jet Technology Association, 1987).
[3] SSPC-SP 1 (latest revision), "Solvent Cleaning" (Pittsburgh, PA: SSPC).

Provided by : www.spic.ir Licensee: NISOC Library

3.3 The specifier shall use one of the visual surface preparation definitions (WJ-1 to WJ-4) and one of the nonvisual surface preparation definitions (SC-1 to SC-3) to specify the degree of visible and nonvisible surface matter to be removed, when deemed necessary. An example of a specification statement would be, "All surfaces to be recoated shall be cleaned in accordance with NACE/SSPC WJ-2/SC-1; the method of HP WJ or UHP WJ ultimately selected by the contractor will be based on his confidence in the capabilities of the equipment and its components." The specifier and contractor shall agree on the test method to be used for determining the amount of nonvisible contaminants.

3.4 The specifier shall consult with the coating manufacturer to ascertain the tolerance of the candidate coating(s) to surface conditions existing after water jetting, commensurate with the in-service application.

**TABLE 1**
**Visual Surface Preparation Definitions**

| Condition | **Description of surface** (when viewed without magnification) |
|---|---|
| WJ-1 | A WJ-1 surface shall be free of all previously existing visible rust, coatings, mill scale, and foreign matter and have a matte metal finish.[A,B,C] |
| WJ-2 | A WJ-2 surface shall be cleaned to a matte finish with at least 95% of the surface area free of all previously existing visible residues and the remaining 5% containing only randomly dispersed stains of rust, coatings, and foreign matter.[A,B,C] |
| WJ-3 | A WJ-3 surface shall be cleaned to a matte finish with at least two-thirds of the surface free of all visible residues (except mill scale), and the remaining one-third containing only randomly dispersed stains of previously existing rust, coatings, and foreign matter.[A,C] |
| WJ-4 | A WJ-4 surface shall have all loose rust, loose mill scale, and loose coatings uniformly removed.[C] |

[A] NOTE: HP WJ and UHP WJ surfaces do not exhibit the hue of a dry abrasive-blasted steel surface. The matte finish color of clean steel immediately after WJ will turn to a golden hue unless an inhibitor is used or environmental controls are employed. On older steel surfaces that have areas of paint or are paint-free, the matte finish color will vary even though all visible surface material has been removed.
[B] UHP WJ at pressures in excess of 240 MPa (35,000 psi) are capable of removing mill scale, but production rates may or may not be cost effective in the effort to remove mill scale.
[C] The experience of the contractor and, in many cases, the preparation of a sample area, determine the success of a specific level of HP WJ or UHP WJ in removing an existing coating or sheet lining material, rust scale, rust nodules or tubercles, mill scale, or other tightly adhered matter from a substrate.

**TABLE 2**
**Nonvisual Surface Preparation Definitions[4]**

| Condition | Description of Surface |
|---|---|
| SC-1 | An SC-1 surface shall be free of all detectable levels of contaminants as determined using available field test equipment with sensitivity approximating laboratory test equipment. For purposes of this standard, contaminants are water-soluble chlorides, iron-soluble salts, and sulfates. |
| SC-2 | An SC-2 surface shall have less than 7 µg/cm$^2$ chloride contaminants, less than 10 µg/cm$^2$ of soluble ferrous ion levels, and less than 17 µg/cm$^2$ of sulfate contaminants as verified by field or laboratory analysis using reliable, reproducible test equipment. |
| SC-3 | An SC-3 surface shall have less than 50 µg/cm$^2$ chloride and sulfate contaminants as verified by field or laboratory analysis using reliable, reproducible test equipment. |

[4] Additional information on suitable procedures for extracting and analyzing soluble salts is available in Appendix B.

Provided by : www.spic.ir Licensee: NISOC Library

## Section 4: Safety

4.1 At the prejob conference, all personnel directly and indirectly involved in the water jetting, washing, and cleaning operation shall obtain, thoroughly study, and observe all safety precautions and procedures of the latest issue of "Recommended Practices for the Use of Manually Operated High-Pressure Water Jetting Equipment."

4.2 Safety procedures shall be observed which prevent injury to the operator and other personnel who are in close proximity to the work area.

4.2.1 A pressure control valve or other suitable design shall be used to protect the operator and anyone else within close proximity of the work site. When the operator releases the trigger, the system must immediately interrupt the high- or ultrahigh-pressure water flow. Automatic safety devices must be incorporated into the design of the pump unit.

4.2.2 Safety considerations require the use of well-trained, experienced operators for the safe execution of any high- or ultrahigh-pressure water jetting operation.

4.2.3 Operators shall wear ear plugs, a face shield, a rain suit, and gloves and must have firm footing when using the water jet. The platform shall be stabilized when using swinging scaffolds, bosun chairs, and similar riggings. Other safety devices shall always be considered to prevent possible accidents in special applications.

4.2.4 While the water jet unit is in operation, an attendant shall be present to monitor functional and safety conditions.

4.3 Injuries caused by water cleaning or water jetting equipment can be life threatening. Every operator shall be given a medical alert card and must present this card to medical personnel prior to treatment. The card shall have the following information on it:

"This person has been water jetting at pressures up to 345 MPa (50,000 psi) and/or a water jet velocity up to 870 m/s (2,850 ft/s). People injured by direct contact with high- or ultrahigh-pressure water typically experience unusual infections with microaerophilic organisms. These may be gram-negative pathogens, such as those found in sewage. Before administering treatment, the attending physician shall immediately contact a local poison control center for appropriate treatment information."

---

## Section 5: Cautionary Notes

5.1 Water jetting can be destructive to nonmetallic surfaces. Soft wood, insulation, electric installations, and instrumentation must be protected from direct and indirect water streams.

5.2 Water used in water jetting units must be clean and free of erosive silts or other contaminants that damage pump valves and/or leave deposits on the surface being cleaned. For example, for 240-MPa (35,000-psi) water jetting equipment, drinking-quality water is filtered through 5-µm (or smaller) filters. The cleaner the water, the longer is the service life of the water jetting equipment.

5.3 Any detergents or other types of cleaners used in conjunction with water jetting shall be removed from surfaces prior to applying a coating. Compatibility of the detergents with the special seals and high-alloy metals of the water jetting equipment must be carefully investigated to ensure that UHP WJ machines are not damaged. The manufacturer of the water jetting equipment shall be consulted to ensure compatibility of inhibitors with the equipment if inhibitors will be used with the standard jetting water. The manufacturer of the coatings shall be consulted to ensure compatibility of inhibitors with the coatings.

Provided by : www.spic.ir Licensee: NISOC Library

## Bibliography


Appleman, B.R. "Painting over Soluble Salts: A Perspective." *Journal of Protective Coatings and Linings* 4, 6 (1987): pp. 68-82.

Calabrese, C., and J.R. Allen. "Surface Characterization of Atmospherically Corroded and Blast Cleaned Steel." *Corrosion* 34, 10 (1978): pp. 331-338.

Cathcart, W.P. "Non-Visible Contaminants in Railcar Interiors: Their Significance and Removal." *Journal of Protective Coatings and Linings* 4, 12 (1987): pp. 6, 8-10.

Ferry, K.W. "Cleaning Lined Tank Cars and Unlined Tank Cars for Lining Application." *Materials Performance* 30, 5 (1991): pp. 34-37.

FHWA-RD-91-011. "Effect of Surface Contaminants on Coating Life." McLean, VA: U.S. Department of Transportation, Federal Highway Administration, November 1991. Also available as SSPC Publication 91-07, Pittsburgh, PA: SSPC, 1991.

Flores, S., J. Simancas, and M. Morcillo. "Methods for Sampling and Analyzing Soluble Salts on Steel Surfaces: A Comparative Study." *Journal of Protective Coatings and Linings* 11, 3 (1994): pp. 76-83.

Frenzel, L.M., M. Ginn, and G. Spires. "Application of High-Pressure Water Jetting in Corrosion Control." In *Surface Preparation: The State of the Art.* Eds. B.R. Appleman and H.E. Hower. Pittsburgh, PA: SSPC, 1985.

Frenzel, L.M., and J. Nixon. "Surface Preparation Using High-Pressure Water Blasting." CORROSION/89, paper no. 397. Houston, TX: NACE International, 1989.

Frondistou-Yannas, S. "Effectiveness of Nonabrasive Cleaning Methods for Steel Surfaces." *Materials Performance* 25, 7 (1986): pp. 53-58.

Johnson, W.C. *ASTM Special Publication 841.* Philadelphia, PA: American Society for Testing and Materials, 1984.

McKelvie, A.N. "Can Coatings Successfully Protect Steel, What Are the Ingredients of Success?" *Materials Performance* 19, 5 (1980): p. 13.

McKelvie, A.N. "Steel Cleaning Standards—A Case for Their Reappraisal." *Journal of the Oil and Colour Chemists' Association* 60 (1977): pp. 227-237.

NACE Publication 6G186 (latest revision). "Surface Preparation of Contaminated Steel Surfaces." Houston, TX: NACE International.

NACE Standard TM0170. "Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive." Houston, TX: NACE International, 1970. (Available from NACE International as a historical document only.)

Rex, J. "A Review of Recent Developments in Surface Preparation Methods." *Journal of Protective Coatings and Linings* 7, 10 (1990): pp. 50-58.

*Systems and Specifications: Volume 2 of Steel Structures Painting Manual*. 7th ed. Pittsburgh, PA: SSPC, 1995.

Trimber, K.A. "An Investigation into the Removal of Soluble Salts Using Power Tools and Steam Cleaning." In *The Economics of Protective Coatings: Proceedings of the Steel Structures Painting Council Seventh Annual Symposium*. Pittsburgh, PA: SSPC, 1988.

Trimber, K.A. "Detection and Removal of Chemical Contaminants in Pulp and Paper Mills." *Journal of Protective Coatings and Linings* 5, 11 (1988): pp. 30-37.

Weldon, D.G., A. Bochan, and M. Schleiden. "The Effect of Oil, Grease, and Salts on Coating Performance." *Journal of Protective Coatings and Linings* 4, 6 (1987): pp. 46-58.


Provided by : www.spic.ir Licensee: NISOC Library

## Appendix A—Commentary on Production Rates

A1.1 Water jetting production rates are affected by operator skill and the condition of the steel surface.[5,6] Regardless of the surface conditions, production rates are usually improved when:

(a) The experienced operator gains additional experience with high- and ultrahigh-pressure water jetting; or

(b) Mechanized, automated water jetting equipment is used.

A1.1.1 New metal with tightly adhering mill scale requires the highest level of operator skill and concentration to produce a clean surface by water jetting; older, more corroded or previously coated surfaces require an average level of skill and concentration for desired results. This is the opposite of abrasive blasting, where poor surface conditions require the highest levels of operator skill and concentration.

A1.2 As a general rule, production and ease of removal increase as the water jetting pressure increases.

A1.3 Cleanup time to remove waste material should be considered as part of the overall production rate.

A1.4 Appendix G provides reported case histories relative to production rates.

## Appendix B—Procedures for Extracting and Analyzing Soluble Salts

B1.1 The specifier and contractor shall agree on the test method or procedure to be used for determining the level of nonvisible contaminants. Section 3 contains additional information on surface cleanliness conditions.

B1.2 Procedure for Extracting Soluble Salts by Swabbing

The following procedures may be used to extract the soluble salts from the surface:

(a) SSPC Swabbing Method[1]

(b) ISO[7] Swabbing Method[1]

(c) ISO/DIS 8502-5, Section 5.1, "Washing of the Test Area"[2]

(d) Any suitable controlled washing procedures available may be used if desired. During the washing procedure, clean plastic or rubber gloves should be worn to ensure that the wash water is not accidentally contaminated.

B1.3 Procedure for Extracting Soluble Salts by Surface Cells

(a) Limpet Cell Method[1]

(b) Surface Conductivity Cell Method[1]

(c) Nonrigid Extraction Cell Method[1]

(d) Cell Retrieval Procedure[1]

B1.4 Procedure for Field Analysis of Chloride Ions

The extract retrieved under Procedures B1.2 or B1.3 may be analyzed by one of the following methods:

(a) Chloride Chemical Test Strips[1]

(b) Chloride Chemical Titration Kit[1]

(c) Ion Detection Tube Method[2]

The following laboratory method is available as a referee method:

(a) Specific Chloride Ion Electrode[1]

B1.5 Procedure for Field Analysis of Sulfate Ions

The extract retrieved under Procedures B1.2 or B1.3 may be analyzed by one of the following methods:

(a) Turbidity Field Comparator Methods[1]

(b) Turbidity Method[1]

[5] J.J. Howlett Jr., R. Dupuy, "Ultrahigh-Pressure Water Jetting (UHP WJ): A Useful Tool for Deposit Removal and Surface Preparation," CORROSION/92, paper no. 253 (Houston, TX: NACE International, 1992).
[6] L.M. Frenzel, R. DeAngelis, J. Bates, "Evaluation of 20,000-psi Water Jetting for Surface Preparation of Steel Prior to Coating or Recoating" (1983). Reprints available from Butterworth Jetting, Houston, TX. Also available in L.M. Frenzel, The Cleaner (Three Lakes, WI: Cole Publishing Inc., 1992).
[7] International Organization for Standardization (ISO), 1 rue de Varembe, Case Postale 56, CH-1121 Geneve 20, Switzerland.



Provided by : www.spic.ir Licensee: NISOC Library

c) Field Comparator Method[1]

B1.6 Procedure for Field Analysis of Soluble Iron Salts

The extract retrieved under Procedures B1.2 or B1.3 may be analyzed by one of the following methods:

(a) Ferrous Chemical Test Strips[1]

(b) Field Test for Soluble Ion Corrosion Products[2]

(c) Semiquantitative Test for Ferrous Ions[3]

B1.7 References

1. FHWA-RD-91-011, "Effect of Surface Contaminants on Coating Life" (McLean, VA: U.S. Department of Transportation, Federal Highway Administration, 1991). Also available as SSPC Publication 91-07 (Pittsburgh, PA: SSPC, 1991).

2. ISO/DIS 8502-5, "Preparation of Steel Substrates Before Application of Paint and Related Products - Test for Assessment of Surface Cleanliness - Part 5: Measurement of Chloride on Steel Surfaces Prepared for Painting (Ion Detection Tube Method)" (Geneva, Switzerland: International Organization for Standardization, 1993).

3. NACE Publication 6G186 (latest revision), "Surface Preparation of Contaminated Steel Surfaces" (Houston, TX: NACE International).

## Appendix C—Water Jetting Equipment

C1.1 The commercial water jet unit can be skid, trailer, or truck mounted; can be equipped with various prime movers (diesel, electric motor, etc.); and usually consists of a pump, hoses, and various tools. The tools can be hand-held or mounted on a robot (or traversing mechanism). Water is propelled through a single jet, a fan jet, or multiple rotating jets. Rotation is provided by small electric, air, or hydraulic motors or by slightly inclined orifices in a multiple-orifice nozzle.

C1.2 The units operate at pressures up to 240 MPa (35,000 psi) or higher, using a hydraulic hose with a bursting strength two and one-half times the capability of its maximum-rated operating strength.

C1.3 A water flow rate of 4 to 53 L/min (1 to 14 gal/min) is typical.

C1.4 Pressure loss is a function of the flow rate of the water through the hose and the inside diameter of the hose. Consult the manufacturer for specific information on potential pressure loss for each type of equipment.

C1.5 Water jets are produced by orifices, or tips, which can have different forms. The higher the pressure, the more limited is the choice of forms. At 240 MPa (35,000 psi), the round jet can be produced reliably. Other orifices, such as fan jets, are available, but service may be limited. Tips can be designed to produce multiple jets of water that are normally rotated to achieve higher material removal rates. In general, round jets are "cutters" while fan jets are "scrapers" and/or "pushers." Interchangeable nozzle tips should be used to produce the desired streams. Consult the manufacturer for specific recommendations.

## Appendix D—Operating Procedures

D1.1 Although a water jetting machine will produce a concentrated stream of water through a hose and nozzle at pressures of 70 to 345 MPa (10,000 to 50,000 psi), with current technology the most practical pressures for surface preparation cleaning are between 70 to 240 MPa (10,000 to 35,000 psi). Under certain conditions, lower water pressures may be used. The use of ultrahigh pressure with reduced water volume produces less thrust with less operator fatigue. The results obtained by HP WJ and UHP WJ are not necessarily similar. For example, surface grease and oil may not be removed by HP WJ at 70 MPa (10,000 psi); surface oil and grease are removed during the water jet process with UHP WJ at 207 MPa (30,000 psi).

D1.2 Typically, the water jet nozzle should be held 5 to 25 cm (2 to 10 in.) from the surface that is being cleaned; in some cases a distance of 0.6 m to 1 m (2 to 3 ft) may achieve the desired cleaning. When ultrahigh-pressure water jetting, the nozzle will be held 6 to 13 mm (0.25 to 0.5 in.) from the substrate in some instances. Consult the manufacturer for specific recommendations.

D1.3 To remove heavy rust scale, the water jet nozzle should be held 5 cm (2 in.) from the surface being cleaned. This distance provides great impact, so the work is performed quickly. Ultrahigh-pressure equipment should be held 6 to 13 mm (0.25 to 0.5 in.) from the surface.

D1.4 The angle of the nozzle and distance from the surface should be determined by the type of matter to be removed and the type of equipment (e.g., HP WJ or UHP WJ) being used.

Provided by : www.spic.ir Licensee: NISOC Library

D1.4.1 To remove brittle substances such as aged paint or rust scale, the nozzle should be held virtually perpendicular to the surface.

D1.4.2 To remove heavy mastics, the nozzle should be held at angles up to 45° to peel the mastic away from the surface.

D1.5 Rust inhibitors, if specified to prevent oxidation of bare steel, may be injected at the nozzle or at the water supply. Coating manufacturers should be consulted to determine the compatibility of the coating to be applied with the type of inhibitor used.

## Appendix E—Efficiency of Water Jetting at Various Pressure Ratings

E1.1 Current published data on the levels of high-pressure water jetting required to remove rust, paint, mill scale, and other contaminants are incomplete due to the recent introduction of pressures of 250 MPa (36,000 psi). However, descriptions of the results of the 1983 study, "Evaluation of 20,000-psi Water Jetting for Surface Preparation of Steel Prior to Coating or Recoating," are given in Paragraphs E1.1.1, E1.1.2, and E1.1.3.[6] Further research is being to validate preliminary data. As additional data become available, this information will be inserted in the appendices to update the information contained within this standard.

E1.1.1 At pressures less than 70 MPa (10,000 psi), loose rust, debris, and material in depressions and pits will be removed, but black oxide (magnetite) remains. A uniform matte finish cannot be achieved.

E1.1.2 At pressures of 70 MPa (10,000 psi), a uniform matte finish is obtained that quickly turns to a golden hue unless inhibitors or environmental controls are employed. Black oxide products (magnetite) will be slowly removed, but not fast enough to be a practical industry application.

E1.1.3 At pressures of 140 MPa (20,000 psi), a uniform matte finish is obtained that quickly turns to a golden hue unless inhibitors or environmental controls are employed. Black oxide products (magnetite), paint, elastomeric coatings, enamel, red oxide, and polypropylene sheet lining are removed. Generally, chemical contaminants will be removed with varying degrees of effectiveness.

E1.1.4 At pressures of 235 to 250 MPa (34,000 to 36,000 psi), a uniform matte finish is obtained that quickly turns to a golden hue unless inhibitors or environmental controls are employed. Surface material, including most mill scale, is removed from the base material. Extremely well-bonded mill scale may require additional time spent in localized jetting. Nonvisible chemical contaminants (i.e., chlorides, sulfates, etc.) will be removed along with most radioactive materials. Removal of base material may occur with prolonged application at these pressures.

E1.2 Test results from Howlett and Dupuy[5] clearly demonstrate that UHP WJ is superior to dry abrasive blasting in removing chlorides to safe levels. Their work consisted of determining the amount of chlorides, sulfate, phosphates, and nitrates after employing various methods of surface preparation, including dry abrasive blasting and inhibited and uninhibited ultrahigh-pressure water jetting.

## Appendix F—Principles of Water Jetting

F1.1 *Water jetting* is the term used when energy is utilized in the removal of existing coatings and/or surface preparation for the subsequent application of a coating. To understand how much energy is in the stream of water, the following dimensionless mathematical expression defines the relationship between power, pressure, and flow rate:

$$Power = \frac{Pressure\ (P)\ x\ FlowRate\ (Q)}{K} \quad (1)$$

K is a constant whose value is determined by the units of measure being used (i.e., metric [MPa, L/min, kW] or English [psi, gal/min, hp]).

For example:

$$Power = \frac{(P)(Q)}{60} \quad (2)$$

with P in MPa,[8] Q in L/min, and power in "hydraulic" kW; or:

[8] For P in bar, K = 600.

Provided by : www.spic.ir Licensee: NISOC Library

$$Power = \frac{(P)(Q)}{1714} \quad (3)$$

with P in psi, Q in gal/min, and power in "hydraulic" hp.

F1.1.1 The above formulas cannot be used without exercising application judgment. For example:

240 MPa (35,000 psi) x 19 L/min (5 gal/min) ÷ 60 (1714) = 76 kW (102 hp)

35 MPa (5,000 psi) x 132 L/min (35 gal/min) ÷ 60 (1714) = 76 kW (102 hp)

Putting 76 kW (102 hp) to work in the form of 19 L/min (5 gal/min) at 240 MPa (35,000 psi) and successfully removing a tough coating does NOT mean 132 L/min (35 gal/min) at 35 MPa (5,000 psi) will produce the same results.

F1.1.2 Application judgment is employed by operators or users who make the decisions concerning which type of energized water to use:

(a) HP WC (the water's flow rate is the predominant energy characteristic);

(b) HP WJ (pressure and flow rate play an equal role); or

(c) UHP WJ (the pressure [i.e., the velocity of the water] is the dominant energy characteristic).

The threshold pressure[9] of a coating must also be determined. In general, the tougher or harder the coating (i.e., the more resistant to the pocketknife test), the higher the threshold pressure will be; the softer and more jelly-like the coating, the lower the threshold pressure will be.

F1.1.2.1 Once the threshold pressure is achieved or exceeded, the production rate increases dramatically. Therefore, water jetting production rates are affected by two conditions:

(a) Erosion at pressures lower than the threshold pressure, and

(b) Water jet cutting plus erosion at pressures greater than the threshold pressure.

F1.1.3 Another way to look at energized water is to determine its energy density, or the amount of hydraulic energy per unit area (the amount of kW [hp] per orifice area). With regard to the examples in Paragraph F1.1.1, consider the following:

UHP WJ: 19 L/min (5 gal/min) at 240 MPa (35,000 psi) requires a 0.9-mm (0.036-in.) diameter orifice that has an area of 0.65 $mm^2$ (0.0010 $in.^2$).

76 kW/0.65 $mm^2$ = 117 $kW/mm^2$
102 hp/0.0010 $in.^2$ = 102,000 $hp/in.^2$

HP WC: 132 L/min (35 gal/min) at 35 MPa (5,000 psi) requires a 3.8-mm (0.15-in.) diameter orifice that has an area of 11.6 $mm^2$ (0.018 $in.^2$)

76 kW/12 $mm^2$ = 6.55 $kW/mm^2$
102 hp/0.018 $in.^2$ = 5,700 $hp/in.^2$

Compare the energy density of UHP WJ and HP WC. UHP jets have 18 times the energy density of HP WC jets.

As water passes through the orifice, the orifice converts potential energy (pressure) to kinetic energy (1/2 $mv^2$). The energy increases linearly with the mass flow, but increases with the square of the velocity.

$$KineticEnergy = \frac{1}{2}\, mv^2 \quad (4)$$

where m = mass and v = velocity. (Velocity is derived from pressure; mass is derived from water volume.)

## Appendix G—Reported Case Histories on Production Rates

NOTE: This appendix consists of case histories that have not been verified by independent NACE/SSPC studies.

G1.1 In the 1983 case of removal of heavy rust from new steel with some intact mill scale, dry abrasive blasting was approximately twice as fast as 140-MPa (20,000-psi) water jetting. In the case of heavy rust 6 to 10 mm (0.25 to 0.38 in.) thick on old steel with no mill scale or paint, water jetting was three to four times faster than the dry blast. In the case of blasted steel that was rusted by salt water and chemical contaminants, dry abrasive blasting was simply not able to clean the corrosion cells. Water jetting not only removed the rust in the second and third cases, but it also cleaned the corrosion cells.[6]

[9] Threshold pressure is defined as the applied water jetting pressure at which the coating to be removed begins to lose its adhesion.

Provided by : www.spic.ir Licensee: NISOC Library

G1.2 When 140-MPa (20,000 psi) water jetting was used in 1983 to clean a coal scrubber plate coated with elastomeric polyurethane, the production rate to commercial finish was approximately six times that of dry abrasive blasting. Water jetting also removed the sulfur contaminants that had migrated to the metal wall. The adhesion of polyurethane to the steel was above 5 MPa (700 psi) when measured with an adhesion tester. The surface profile on this steel, which had initially been sand blasted to 130 µm (5 mils), remained the same. The contour looked like a sand-blasted pattern except that loose material in the valleys had been removed. The same phenomenon was observed when steel panels (UNS[10] G10200) that had been rusted in salt chambers were cleaned with 140-MPa (20,000-psi) water jetting. The anchor pattern was unchanged from the original sand-blast pattern; the top view looked like a sand-blast pattern except loose material was absent.[6]

G1.3 The 1983 cleaning rate for water jetting at 140 MPa (20,000 psi) for the removal of 1,000-µm (40-mil) urethane coatings on flue gas scrubbers is 0.7 $m^2$/h (7.5 $ft^2$/h).[6]

G1.4 The 1983 cleaning rate for water jetting at 140 MPa (20,000 psi) for the removal of nonskid urethane coatings is 2.9 $m^2$/h (31 $ft^2$/h).[6]

G1.5 The 1983 cleaning rate for water jetting at 140 MPa (20,000 psi) for the removal of thick rust and 50% paint coverage on pitted barge steel to a near-white condition is 5.6 $m^2$/h (60 $ft^2$/h).[6]

G1.6 Table G-1 provides 1991 cleaning rates for water jetting at 240 MPa (35,000 psi). At 240 MPa (35,000 psi) water jetting is two to three times faster than at 70 MPa (10,000 psi) in achieving the same degree of cleanliness.

G1.7 Table G-2 provides 1994 cleaning rates for water jetting at 207 MPa (30,000 psi).

**TABLE G-1[11]**
**UHP Water Jetting Cleaning Rates at 240 MPa (35,000 psi)**
**21 L/min (5.6 gal/min) Water Usage**

| Original Condition | Cleaning Rates $m^2$/h ($ft^2$/h) |
|---|---|
| 1000-µm (40-mil) urethane coating on flue gas scrubbers | 1.4 to 1.9 (15 to 20) |
| Nonskid urethane coatings | 2.8 (30) |
| Thick, rust-pitted steel on barge; flat surface; 50% paint coverage; water jet to WJ-2 | 5.6 (60) |

**TABLE G-2[12]**
**UHP Water Jetting Cleaning Rates at 207 MPa (30,000 psi)**
**10 L/min (2.8 gal/min) Water Usage**

| Original Condition | Cleaning Rates $m^2$/h ($ft^2$/h) |
|---|---|
| Multiple-layer ship hull coatings | 7.0 to 9.5 (75 to 100) |
| Nonskid urethane coatings | 19 (200) |

[10] Metals and Alloys in the Unified Numbering System (latest revision), a joint publication of the American Society for Testing and Materials (ASTM) and the Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096.
[11] 1991 data.
[12] 1994 data.

Provided by : www.spic.ir Licensee: NISOC Library

# Joint Surface Preparation Standard
# SSPC-SP 13/NACE No. 6
# Surface Preparation of Concrete

This SSPC: The Society for Protective Coatings/NACE International (NACE) standard represents a consensus of those individual members who have reviewed this document, its scope, and provisions. Its acceptance does not in any respect preclude anyone, whether he has adopted the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not in conformance with this standard. Nothing contained in this SSPC/NACE standard is to be construed as granting any right, by implication or otherwise, to manufacture, sell, or use in connection with any method, apparatus, or product covered by Letters Patent, or as indemnifying or protecting anyone against liability for infringement of Letters Patent. This standard represents minimum requirements and should in no way be interpreted as a restriction on the use of better procedures or materials. Neither is this standard intended to apply in all cases relating to the subject. Unpredictable circumstances may negate the usefulness of this standard in specific instances. NACE and SSPC assume no responsibility for the interpretation or use of this standard by other parties and accept responsibility for only those official interpretations issued by NACE or SSPC in accordance with their governing procedures and policies which preclude the issuance of interpretations by individual volunteers.

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

CAUTIONARY NOTICE: SSPC/NACE standards are subject to periodic review, and may be revised or withdrawn at any time without prior notice. NACE and SSPC require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of initial publication. The user is cautioned to obtain the latest edition.

©1997, SSPC and NACE International

NACE International
P.O. Box 218340
Houston, TX 77218-8340
+1 281/228-6200

SSPC: The Society for Protective Coatings
40 24th St.
Pittsburgh, PA 15222
+1 412/281-2331

Provided by : www.spic.ir Licensee: NISOC Library

# Joint Surface Preparation Standard
# SSPC-SP 13/ NACE No. 6
# Surface Preparation of Concrete

## Foreword

This standard covers the preparation of concrete surfaces prior to the application of protective coating or lining systems. This standard should be used by specifiers, applicators, inspectors, and others who are responsible for defining a standard degree of cleanliness, strength, profile, and dryness of prepared concrete surfaces.

This standard was prepared by SSPC/NACE Joint Task Group F on Surface Preparation of Concrete. This joint task group includes members from both NACE Unit Committee T-6G and SSPC Group Committee C.2 on Surface Preparation.

In NACE standards, the terms *shall*, *must*, *should*, and *may* are used in accordance with the definitions of these terms in the *NACE Publications Style Manual*, 3rd ed., Paragraph 8.4.1.8. *Shall* and *must* are used to state mandatory requirements. *Should* is used to state that which is considered good and is recommended but is not absolutely mandatory. *May* is used to state that which is considered optional.

## Contents

1. General
2. Definitions
3. Inspection Procedures Prior to Surface Preparation
4. Surface Preparation
5. Inspection and Classification of Prepared Concrete Surfaces
6. Acceptance Criteria
7. Safety and Environmental Requirements

References

Appendix A—Comments

Provided by : www.spic.ir Licensee: NISOC Library

## Section 1: General

1.1 This standard gives requirements for surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems.

1.2 The requirements of this standard are applicable to all types of cementitious surfaces including cast-in-place concrete floors and walls, precast slabs, masonry walls, and shotcrete surfaces.

1.3 An acceptable prepared concrete surface should be free of contaminants, laitance, loosely adhering concrete, and dust, and should provide a sound, uniform substrate suitable for the application of protective coating or lining systems.

1.4 When required, a minimum concrete surface strength, maximum surface moisture content, and surface profile range should be specified in the procurement documents (project specifications).

1.5 The mandatory requirements of this standard are given in Sections 1 to 7 as follows:

Section 1: General
Section 2: Definitions
Section 3: Inspection Procedures Before Surface Preparation
Section 4: Surface Preparation
Section 5: Inspection and Classification of Prepared Concrete Surfaces
Section 6: Acceptance Criteria
Section 7: Safety and Environmental Requirements

1.6 Appendix A does not contain mandatory requirements.

## Section 2: Definitions

**Bugholes:** Small regular or irregular cavities, usually not exceeding 15 mm in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and compaction.[1]

**Coating:** See *Protective Coating or Lining System*.

**Concrete:** A material made from hydraulic cement and inert aggregates, such as sand and gravel, which is mixed with water to a workable consistency and placed by various methods to harden and gain strength.

**Curing (Concrete):** The maintenance of satisfactory moisture content and temperature in concrete during its early stages so that desired properties may develop.[1]

**Curing Compound (Membrane Curing Compound):** A liquid that can be applied as a coating to the surface of newly placed concrete to retard the loss of water.[1]

**Efflorescence:** A white crystalline or powdery deposit on the surface of concrete. Efflorescence results from leaching of lime or calcium hydroxide out of a permeable concrete mass over time by water, followed by reaction with carbon dioxide and acidic pollutants.[2]

**Fin:** A narrow linear projection on a formed concrete surface, resulting from mortar flowing into spaces in the form work.[1]

**Finish:** The texture of a surface after compaction and finishing operations have been performed.[1]

**Finishing:** Leveling, smoothing, compacting, and otherwise treating surfaces of fresh or recently placed concrete or mortar to produce desired appearance and service.[1]

**Hardener (Concrete):** A chemical (including certain fluorosilicates or sodium silicate) applied to concrete floors to reduce wear and dusting.[1]

**High-Pressure Water Cleaning (HP WC):** HP WC is cleaning performed at pressures from 34 to 70 MPa (5,000 to 10,000 psi).[3]

**High-Pressure Water Jetting (HP WJ):** HP WJ is cleaning performed at pressures from 70 to 170 MPa (10,000 to 25,000 psi).[3]

**Honeycomb:** Voids left in concrete due to failure of the mortar to effectively fill the spaces among coarse aggregate particles.[1]

**Laitance:** A thin, weak, brittle layer of cement and aggregate fines on a concrete surface. The amount of laitance is influenced by the type and amount of admixtures, the degree of working, and the amount of water in the concrete.[2]

Provided by : www.spic.ir Licensee: NISOC Library

**Lining:** See *Protective Coating or Lining System*.

**pH:** The negative logarithm of the hydrogen ion activity written as:

$$pH = -\log_{10} (a_{H}^{+})$$

where $a_{H}^{+}$ = hydrogen ion activity = the molar concentration of hydrogen ions multiplied by the mean ion-activity coefficient.[4]

**Placing:** The deposition, distribution, and consolidation of freshly mixed concrete in the place where it is to harden.[1]

**Porosity:** Small voids that allow fluids to penetrate an otherwise impervious material.

**Protective Coating or Lining System (Coating):** Protective coating or lining systems (also called *protective barrier systems*) are bonded thermoset, thermoplastic, inorganic, organic/inorganic hybrids, or metallic materials applied in one or more layers by various methods such as brush, roller, trowel, spray, and thermal spray. They are used to protect concrete from degradation by chemicals, abrasion, physical damage, and the subsequent loss of structural integrity. Other potential functions include containing chemicals, preventing staining of concrete, and preventing liquids from being contaminated by concrete.

**Release Agents (Form-Release Agents):** Materials used to prevent bonding of concrete to a surface.[1]

**Sealer (Sealing Compound):** A liquid that is applied as a coating to a concrete surface to prevent or decrease the penetration of liquid or gaseous media during exposure. Some curing compounds also function as sealers.

**Soundness:** A qualitative measure of the suitability of the concrete to perform as a solid substrate or base for a coating or patching material. Sound concrete substrates usually exhibit strength and cohesiveness without excessive voids or cracks.

**Spalling:** The development of spalls which are fragments, usually in the shape of a flake, detached from a larger mass by a blow, by the action of weather, by pressure, or by expansion within the larger mass.[1]

**Surface Porosity:** Porosity or permeability at the concrete surface that may absorb vapors, moisture, chemicals, and coating liquids.

**Surface Preparation:** The method or combination of methods used to clean a concrete surface, remove loose and weak materials and contaminants from the surface, repair the surface, and roughen the surface to promote adhesion of a protective coating or lining system.

**Surface Profile (Texture):** Surface contour as viewed from edge.

**Surface Voids (see also Bugholes):** Cavities visible on the surface of a solid.[1]

## Section 3: Inspection Procedures Prior to Surface Preparation

3.1 Concrete shall be inspected prior to surface preparation to determine the condition of the concrete and to determine the appropriate method or combination of methods to be used for surface preparation to meet the requirements of the coating system to be applied. Inherent variations in surface conditions seen in walls and ceilings versus those in floors should be considered when choosing surface preparation methods and techniques. For example, walls and ceilings are much more likely than floors to contain bugholes, fins, form-release agents, and honeycombs.

3.2 Visual Inspection

All concrete surfaces that will be prepared and coated shall be visually inspected for signs of concrete defects, physical damage, chemical damage, contamination, and excess moisture.

3.3 Concrete Cure

All concrete should be cured using the procedures described in ACI[(1)] 308.[5] Curing requirements include maintaining sufficient moisture and temperatures for a minimum time period. Surface preparation performed on insufficiently cured or low-strength concrete may create an excessively coarse surface profile or remove an excessive amount of concrete.

3.4 Concrete Defects

Concrete defects such as honeycombs and spalling shall be repaired. The procedures described in NACE Standard RP0390,[6] ICRI[(2)] 03730,[7] or ACI 301[8] may be used to ensure that the concrete surface is sound prior to surface preparation.

3.5 Physical Damage

(1) American Concrete Institute International (ACI), 38800 International Way, Country Club Drive, Farmington Hills, MI 48331.
(2) International Concrete Repair Institute (ICRI), 1323 Shepard Dr., Sterling, VA 20164-4428.



Provided by : www.spic.ir Licensee: NISOC Library

3.5.1 Concrete should be tested for soundness by the qualitative methods described in NACE Publication 6G191[9] or Paragraph A1.4.3.

3.5.2 When qualitative results are indeterminate, or when a quantitative result is specified, concrete shall be tested for surface tensile strength using the methods described in Paragraph A1.6.

3.5.3 Concrete that has been damaged due to physical forces such as impact, abrasion, or corrosion of reinforcement shall be repaired prior to surface preparation if the damage would affect coating performance. Repairs should be made in accordance with ACI 301,[8] NACE Standard RP0390,[6] or Paragraph A1.4.

3.6 Chemical Damage

3.6.1 Concrete is attacked by a variety of chemicals, as detailed in ACI 515.1R[10] and PCA[(3)] IS001.08T.[11]

3.6.2 All concrete surfaces that have been exposed to chemicals shall be tested and treated for contamination as described in Paragraph 3.7.

3.6.3 Concrete that has been exposed to chemicals shall be tested for soundness by the qualitative methods described in NACE Publication 6G191[9] or Paragraph A1.4.3.

3.7 Contamination

3.7.1 Contamination on concrete surfaces includes all materials which may affect the adhesion and performance of the coating to be applied. Examples include, but are not limited to, dirt, oil, grease, chemicals, and existing incompatible coatings.

3.7.2 Contamination may be detected by methods described in NACE Publication 6G191[9] and Paragraph A1.5. These methods include, but are not limited to, visual examination, water drop (contact angle) measurement, pH testing, petrographic examination, and various instrumental analytical methods. Core sampling may be required to deter-mine the depth to which the contaminant has penetrated the concrete.

3.7.3 Concrete surfaces that are contaminated or that have existing coatings shall be tested to determine whether the contamination or existing coating will affect the adhesion and performance of the coating to be applied. Concrete surfaces that have existing coatings shall also be tested to determine whether the existing coating is sufficiently bonded to the concrete.

3.7.4 In extreme cases of concrete damage or degradation, or thorough penetration by contaminants, complete removal and replacement of the concrete may be required.

3.8 Moisture

Moisture levels in the concrete may be determined by the methods described in Paragraph 5.6.

## Section 4: Surface Preparation

4.1 Objectives

4.1.1 The objective of surface preparation is to produce a concrete surface that is suitable for application and adhesion of the specified protective coating system.

4.1.2 Protrusions such as form burrs, sharp edges, fins, and concrete spatter shall be removed during surface preparation if they will interfere with the performance of the coating to be applied.

4.1.3 Voids and other defects that are at or near the surface shall be exposed during surface preparation.

4.1.4 All concrete that is not sound shall be removed so that only sound concrete remains.

4.1.5 Concrete damaged by exposure to chemicals shall be removed so that only sound concrete remains.

4.1.6 All contamination, form-release agents, efflorescence, curing compounds, and existing coatings determined to be incompatible with the coating to be applied shall be removed.

4.1.7 The surface preparation method, or combination of methods, should be chosen based on the conditions of the concrete and the requirements of the coating system to be applied.

4.1.8 All prepared concrete surfaces shall be repaired to the level required by the coating system in the intended service condition.

(3) Portland Cement Association (PCA), 5420 Old Orchard Rd., Skokie, IL 60077.

Provided by : www.spic.ir Licensee: NISOC Library

4.2 Surface Cleaning Methods

4.2.1 Surface cleaning methods shall not be used as the sole surface preparation method of concrete to be coated as they will not remove laitance or contaminants or alter the surface profile of concrete. These methods shall be used as required, before and/or after the mechanical and chemical methods described in Paragraphs 4.3 and 4.4.

4.2.2 Vacuum cleaning, air blast cleaning, and water cleaning as described in ASTM[4] D 4258[12] may be used to remove dirt, loose material, and/or dust from concrete.

4.2.3 Detergent water cleaning and steam cleaning as described in ASTM D 4258[12] may be used to remove oils and grease from concrete.

4.3 Mechanical Surface Preparation Methods

4.3.1 Dry abrasive blasting, wet abrasive blasting, vacuum-assisted abrasive blasting, and centrifugal shot blasting, as described in ASTM D 4259,[13] may be used to remove contaminants, laitance, and weak concrete, to expose subsurface voids, and to produce a sound concrete surface with adequate profile and surface porosity.

4.3.2 High-pressure water cleaning or water jetting methods as described in NACE No. 5/SSPC-SP 12,[3] ASTM D 4259,[13] or "Recommended Practices for the Use of Manually Operated High Pressure Water Jetting Equipment,"[5][14] may be used to remove contaminants, laitance, and weak concrete, to expose subsurface voids, and to produce a sound concrete surface with adequate profile and surface porosity.

4.3.3 Impact-tool methods may be used to remove existing coatings, laitance, and weak concrete. These methods include scarifying, planing, scabbling, and rotary peening, as described in ASTM D 4259.[13] Impact-tool methods may fracture concrete surfaces or cause microcracking and may need to be followed by one of the procedures in Paragraphs 4.3.1 or 4.3.2 to produce a sound concrete surface with adequate profile and surface porosity. The soundness of a concrete surface prepared using an impact method may be verified by one of the surface tensile strength tests described in Paragraph A1.6.

4.3.4 Power-tool methods, including circular grinding, sanding, and wire brushing as described in ASTM D 4259,[13] may be used to remove existing coatings, laitance, weak concrete, and protrusions in concrete. These methods may not produce the required surface profile and may require one of the procedures described in Paragraphs 4.3.1 or 4.3.2 to produce a concrete surface with adequate profile and surface porosity.

4.3.5 Surface preparation using the methods described in Paragraphs 4.3.1 through 4.3.4 shall be performed in a manner that provides a uniform, sound surface that is suitable for the specified protective coating system.

4.4 Chemical Surface Preparation

Acid etching, as described in ASTM D 4260[15] and NACE Standard RP0892,[16] may be used to remove some surface contaminants, laitance, and weak concrete and to provide a surface profile on horizontal concrete surfaces. This method requires complete removal of all reaction products and pH testing to ensure neutralization of the acid. Acid etching is not recommended for vertical sur-faces and areas where curing compounds or sealers have been used. Acid etching shall only be used where procedures for handling, containment, and disposal of the hazardous materials are in place. Acid etching with hydrochloric acid shall not be used where corrosion of metal in the concrete (rebar or metal fibers) is likely to occur.

4.5 Flame (Thermal) Cleaning and Blasting

4.5.1 Flame cleaning using a propane torch or other heat source may be used to extract organic contaminants from a concrete surface. This type of cleaning may need to be followed by the cleaning methods described in ASTM D 4258[12] to remove the extracted contaminants.

4.5.2 Flame cleaning and blasting using oxygen-acetylene flame blasting methods and proprietary delivery equipment may be used to remove existing coatings, contaminants, and laitance and/or create a surface profile on sound concrete.

4.5.3 The extent of removal when employing flame methods is affected by the rate of equipment advancement, the flame adjustment, and the distance between the flame and the concrete surface. Surface preparation using flame methods shall be performed in a manner that provides a uniform, sound surface that is suitable for the specified protective coating system.

4.5.4 High temperatures will reduce the strength of or damage concrete; therefore, surfaces prepared using flame methods shall be tested for soundness

[4] American Society for Testing and Materials (ASTM), 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959.
[5] Water Jet Technology Association (WJTA), 818 Olive St., Suite 918, St. Louis, MO 63101-1598.

Provided by : www.spic.ir Licensee: NISOC Library

and surface tensile strength. Concrete surfaces found to be unsound or low in tensile strength shall be repaired or prepared by other mechanical methods described in Paragraph 4.3.

4.6 Surface Cleanliness

After the concrete surface has been prepared to the required soundness and surface profile, surfaces may still need to be cleaned by one of the methods described in Paragraph 4.2 to remove the residue created by the surface preparation method or to remove spent media.

4.7 Moisture Content

If the moisture level in the concrete is higher than the specified limit that the coating will tolerate, the concrete shall be dried or allowed to dry to the level specified in the procurement documents before inspection and application of the coating (see Paragraph 5.6).

4.8 Patching and Repairs

4.8.1 The prepared concrete surface shall be inspected according to Section 5 prior to proceeding with patching and repairs. After the patching and repairs of the concrete surface are completed, the repaired areas shall be reinspected according to Section 5.

4.8.2 All voids, gouges, bugholes, and other surface anomalies shall be repaired to a level required by the coating system as specified in the procurement documents.

4.8.3 All repair materials, both cementitious and polymeric, should be approved or recommended by the coating manufacturer as being compatible with the coating to be applied. Repair materials not recommended or approved by the coating manufacturer shall be tested for compatibility prior to their application.

4.8.4 The repair material shall be cured according to the manufacturer's published instructions.

4.8.5 The repaired section may require additional surface preparation prior to coating application.

## Section 5: Inspection and Classification of Prepared Concrete Surfaces

5.1 Surface Tensile Strength

5.1.1 All prepared concrete surfaces should be tested for surface tensile strength after cleaning and drying but prior to making repairs or applying the coating.

5.1.2 Surface tensile strength should be tested using a method agreed upon by all parties. (See Para-graph A1.6 for commentary on these methods.)

5.2 Coating Adhesion

5.2.1 If specified in the procurement documents and accepted by all parties, a test patch shall be applied to determine the compatibility of and adhesion between the prepared surface and the coating system (see Paragraph A1.6.3 for commentary on this method.)

5.2.2 Coating adhesion should be tested using one of the methods agreed upon by all parties. (See Paragraph A1.6 for commentary on these methods.)

5.3 Surface Profile

5.3.1 If a specific surface profile is required for the performance of the coating system to be applied, the profile shall be specified in the procurement documents.

5.3.2 The surface profile of prepared concrete surfaces should be evaluated after cleaning and drying but prior to repairs or application of the coating.

5.3.3 The surface profile may be evaluated by comparing the profile of the prepared concrete surface with the profile of graded abrasive paper, as described in ANSI[6] B74.18,[17] by comparing the profile with the ICRI Guideline No. 03732[18] (surface profile chips) or by another agreed-upon visual comparison.

5.4 Surface Cleanliness

5.4.1 All prepared concrete surfaces shall be inspected for surface cleanliness after cleaning and drying but prior to making repairs or applying the coating. If the concrete surfaces are repaired, they shall be reinspected for surface cleanliness prior to applying the coating.

[6] American National Standards Institute (ANSI), 11 West 42nd St., New York, NY 10036.

Provided by : www.spic.ir Licensee: NISOC Library

5.4.2 Prepared concrete surfaces may be inspected for surface cleanliness by lightly rubbing the surface with a dark cloth or pressing a translucent adhesive tape on the surface. The test method and acceptable level of residual dust shall be agreed on by all parties.

5.4.3 The method used to verify compatibility of the coating to be applied over a contaminated surface or over contaminated surfaces that have been cleaned and prepared should be approved by the coating manufacturer and specified in the procurement documents.

5.5 pH

5.5.1 The pH of the concrete shall be specified in the procurement documents if a specific pH is required for proper performance of the coating system to be applied.

5.5.2 The pH of concrete surfaces prepared by acid etching should be tested after etching and rinsing but before the prepared surface has dried.

5.5.3 ASTM D 4262[19] should be used to determine pH.

5.6 Moisture Content

5.6.1 The moisture content of the concrete shall be specified in the procurement documents if a specific moisture content is required for proper performance of the coating system to be applied.

5.6.2 Prepared concrete surfaces should be tested for residual moisture after cleaning and drying but prior to the application of the coating.

5.6.3 ASTM D 4263[20] or the calcium chloride test[21] should be used to determine the residual moisture content in concrete.

5.6.4 If required or accepted by all parties, any of the methods described in Paragraph A1.8.4 may be used to determine the moisture content of the concrete surface.

## Section 6: Acceptance Criteria

6.1 The acceptance criteria for prepared concrete surfaces shall be specified in the procurement documents.

6.2 The procurement documents may refer to the specifications in Table 1:

**TABLE 1**
**Suggested Acceptance Criteria for Concrete Surfaces After Surface Preparation**

| Property | Test Method | Light Service[A] | Severe Service[B] |
|---|---|---|---|
| Surface tensile strength | See Paragraph A1.6 | 1.4 MPa (200 psi) min. | 2.1 MPa (300 psi) min. |
| Surface profile | Visual comparison[17] | Fine (150) abrasive paper min. | Coarse (60) abrasive paper min. |
| Surface cleanliness | Visible dust[12] | No significant dust | No significant dust |
| Residual contaminants | Water drop[16,22] | 0° contact angle | 0° contact angle |
| pH | ASTM D 4262[19] | (pH of rinse water) -1, +2[C] | (pH of rinse water) -1, +2[C] |
| Moisture content[D] | ASTM D 4263[20] | No visible moisture | No visible moisture |
| Moisture content[D] | Calcium chloride test[21] | 15 g/24 hr/$m^2$ (3 lb/24 hr/ 1,000 $ft^2$) max. | 15 g/24 hr/$m^2$ (3 lb/24 hr/1,000 $ft^2$) max. |
| Moisture content[D] | Hygrometer[23] | 80% max. | 80% max. |

[A] *Light service* refers to surfaces and coatings that will have minimal exposure to traffic, chemicals, and changes in temperature.
[B] *Severe service* refers to surfaces and coatings that will have significant exposure to traffic, chemicals, and/or changes in temperature.
[C] The acceptance criterion for ASTM D 4262 is as follows: The pH readings following the final rinse shall not be more than 1.0 lower or 2.0 higher than the pH of the rinse water (tested at the beginning and end of the final rinse cycle) unless otherwise specified.
[D] Any one of these three moisture content test methods is acceptable.

Provided by : www.spic.ir Licensee: NISOC Library

## Section 7: Safety and Environmental Requirements

7.1 Disposal of contaminants, old coatings, acid from etching, and contaminated water and blasting media shall comply with all applicable facility, local, state, and federal regulations.

7.2 Handling of hazardous materials, machinery operations, worker protection, and control of airborne dust and fumes shall comply with all applicable facility, local, state, and federal health and safety regulations.

---

## References


1. ACI 116R (latest revision), "Cement and Concrete Terminology" (Farmington Hills, MI: American Concrete Institute).

2. SSPC-Guide 11 (latest revision), "Guide for Applying Coatings to Concrete" (Pittsburgh, PA: SSPC).

3. NACE No. 5/SSPC-SP 12, "Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating" (Houston, TX: NACE, and Pittsburgh, PA: SSPC).

4. NACE International Glossary of Corrosion-Related Terms, 2nd ed. (Houston, TX: NACE, 1995).

5. ACI 308 (latest revision), "Standard Practice for Curing Concrete" (Farmington Hills, MI: American Concrete Institute).

6. NACE Standard RP0390 (latest revision), "Maintenance and Rehabilitation Considerations for Corrosion Control of Existing Steel Reinforced Concrete Structures" (Houston, TX: NACE).

7. ICRI Guideline No. 03730 (latest revision), "Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforced Steel Corrosion" (Sterling, VA: International Concrete Repair Institute).

8. ACI 301 (latest revision), "Standard Specification for Structural Concrete" (Farmington Hills, MI: American Concrete Institute).

9. NACE Publication 6G191 (latest revision), "Surface Preparation of Contaminated Concrete for Corrosion Control" (Houston, TX: NACE ).

10. ACI 515.1R (latest revision), "Guide to the Use of Waterproofing, Dampproofing, Protective, and Decorative Barrier Systems for Concrete" (Farmington Hills, MI: American Concrete Institute).

11. IS001.08T (latest revision), "Effect of Substances on Concrete and Guide to Protective Treatments" (Skokie, IL: Portland Cement Association).

12. ASTM D 4258 (latest revision), "Standard Practice for Surface Cleaning Concrete for Coating" (West Conshohocken, PA: ASTM).

13. ASTM D 4259 (latest revision), "Standard Practice for Abrading Concrete" (West Conshohocken, PA: ASTM).

14. Water Jet Technology Association (latest revision), "Recommended Practices for the Use of Manually Operated High-Pressure Water Jetting Equipment" (St. Louis, MO: Water Jet Technology Association).

15. ASTM D 4260 (latest revision), "Standard Practice for Acid Etching Concrete" (West Conshohocken, PA: ASTM).

16. NACE Standard RP0892 (latest revision), "Linings over Concrete for Immersion Service" (Houston, TX: NACE).

17. ANSI B74.18 (latest revision), "Specifications for Grading of Certain Abrasive Grain on Coated Abrasive Products" (New York, NY: American National Standards Institute).

18. ICRI Guideline No. 03732 (latest revision), "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays" (Sterling, VA: International Concrete Repair Institute).

19. ASTM D 4262 (latest revision), "Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces" (West Conshohocken, PA: ASTM).

20. ASTM D 4263 (latest revision), "Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method" (West Conshohocken, PA: ASTM).

21. Work in Progress by Committee E06.21, Task Group 14, "Standard Practices for Determining Moisture-Related Acceptability of Concrete Floors to Receive Moisture-Sensitive Finishes" (West Conshohocken, PA: ASTM).

22. F.S. Gelfant, "Contaminated Concrete—Effect of Surface Preparation Methods on Coating Performance," Journal of Protective Coatings and Linings 12, 12 (1995): pp. 60-72.


Provided by : www.spic.ir Licensee: NISOC Library

23. BS 5325 (latest revision), "British Standard Code of Practice for Installation of Textile Floor Coverings," Appendix A, Dampness Testing (London, England: British Standards Institution).

24. T.I. Aldinger, B.S. Fultz, "Keys to Successfully Preparing Concrete for Coating," Journal of Protective Coatings and Linings 6, 5 (1989): pp. 34-40.

25. T. Dudick, "Concrete Standards for Resinous Toppings," SSPC 93-06: Innovations for Preserving and Protecting Industrial Structures, November 13-18, 1993 (Pittsburgh, PA: SSPC, 1993).

26. R. Boyd, "Quality Control in Cleaning and Coating Concrete," SSPC 91-19: Protective Coatings for Flooring and Other Concrete Surfaces, November 10-15, 1991 (Pittsburgh, PA: SSPC, 1991), pp. 5-7.

27. C.G. Munger, Corrosion Prevention by Protective Coatings (Houston, TX: NACE, 1984), pp. 193-245, 287-303.

28. NACE 6G197/SSPC-TU 2 (latest revision), "Design, Installation, and Repair of Coating Systems for Concrete Used in Secondary Containment," (Houston, TX: NACE, and Pittsburgh, PA: SSPC).

29. ASTM PCN:03-401079-14, "Manual of Coating Work for Light-Water Nuclear Power Plant Primary Containment and Other Safety-Related Facilities" (West Conshohocken, PA: ASTM, 1979), pp. 114-119.

30. H.H. Baker, R.G. Posgay, "The Relationship Between Concrete Cure and Surface Preparation," Journal of Protective Coatings and Linings 8, 8 (1991): pp. 50-56.

31. F. Hazen, "Repairing Concrete Prior to Lining Secondary Containment Structures," Journal of Protective Coatings and Linings 8, 1 (1991): pp. 73-79.

32. ASTM PCN:03-401079-14, "Manual of Coating Work for Light-Water Nuclear Power Plant Primary Containment and Other Safety-Related Facilities" (West Conshohocken, PA: ASTM, 1979), pp. 120-123.

33. C.T. Grimm, "Cleaning Masonry: A Review of the Literature," Publication #TR 2-88, Construction Research Center, (Arlington, TX: University of Texas at Arlington, November 1988).

34. S. Lefkowitz, "Controlled Decontamination of Concrete," Concrete: Surface Preparation, Coating and Lining, and Inspection (Houston, TX: NACE, 1991).

35. R.A. Nixon, "Assessing the Deterioration of Concrete in Pulp and Paper Mills," Concrete: Surface Preparation, Coating and Lining, and Inspection, January 28-30, 1991 (Houston, TX: NACE, 1991).

36. IS214T (latest revision), "Removing Stains and Cleaning Concrete Surfaces," (Skokie, IL: Portland Cement Association).

37. J. Steele, "Testing Adhesion of Coatings Applied to Concrete," Materials Performance 33, 11 (1994): pp. 33-36.

38. ASTM D 4541 (latest revision), "Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers" (West Conshohocken, PA: ASTM).

39. ACI 503R (latest revision), "Use of Epoxy Compounds with Concrete" (Farmington Hills, MI: American Concrete Institute).

40. ASTM D 4541-93, "Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers" (West Conshohocken, PA: ASTM).

41. T.K. Greenfield, "Dehumidification Equipment Reduces Moisture in Concrete During Coating Application," Materials Performance 33, 3 (1994): pp. 39-40.

42. L. Harriman, "Drying and Measuring Moisture in Concrete—Part I," Materials Performance 34, 1 (1995): pp. 34-36.

43. L. Harriman, "Drying and Measuring Moisture in Concrete—Part II," Materials Performance 34, 2 (1995): pp. 34-36.

44. W.H. Riesterer, "Hydrostatic, Capillary, Osmotic and Other Pressures," Innovations for Preserving and Protecting Industrial Structures," November 13-18, 1993 (Pittsburgh, PA: SSPC, 1993).

45. N.C. Duvic, "Surface Preparation of Concrete for Application of Protective Surfacing or Coating," Concrete: Surface Preparation, Coating and Lining, and Inspection (Houston, TX: NACE, 1991).

46. P.J. Fritz, "The Use of Captive Shot (Roto-Peening) for Preparing the Surface of Concrete," SSPC 93-06: Innovations for Preserving and Protecting Industrial Structures, November 13-18, 1993 (Pittsburgh, PA: SSPC, 1993), pp. 144-147.

47. K. Pashina, "Planning, Proper Surface Preparation Essential for Successful Coatings," Concrete Repair Bulletin 7, 1 (1994): pp. 4-8.

48. ASTM PCN:03-401079-14, "Manual of Coating Work for Light-Water Nuclear Power Plant Primary Containment and Other Safety-Related Facilities" (West Conshohocken, PA: ASTM, 1979), pp. 124-127.

49. T.I. Aldinger, "Coating New Concrete: Why Wait 28 Days?" SSPC 91-19: Protective Coatings for Flooring and Other Concrete Surfaces, November 10-15, 1991

Provided by : www.spic.ir Licensee: NISOC Library

(Pittsburgh, PA: SSPC, 1991), pp. 1-4.

50. J. Steele, "Effective Sealing, Priming and Coating of New and Uncured Concrete," Concrete: Surface Preparation, Coating and Lining, and Inspection, January 28-30, 1991 (Houston, TX: NACE, 1991).

51. NACE Standard RP0591 (latest revision), "Coatings for Concrete Surfaces in Non-Immersion and Atmos-pheric Surfaces" (Houston, TX: NACE).

## Appendix A—Comments

*(This section does not contain any mandatory requirements.)*

A1.1 General[24,25,26,27]

A1.1.1 This standard does not recommend surface preparation methods or differentiate levels of surface preparation that are specifically required for various protective system designs, types, thicknesses, and end-use requirements. These specifications should be decided and agreed upon by all parties (the specifier, facility owner, coating manufacturer, and contractor).

A1.1.2 Concrete and its surfaces are not homo-geneous or consistent and, unlike steel, cannot be discretely defined. Therefore, visual examination of a concrete surface is somewhat subjective. The ac-ceptance or rejection of a prepared concrete surface should be based on the results of specific tests, including, but not limited to, tests for surface tensile strength, contamination, and moisture.

A1.1.3 Joints, cracks, and curing shrinkage of con-crete should be considered in the design of the protective coating system; however, these topics are beyond the scope of this standard. See NACE Standard RP0892,[16] ACI 515.1R,[10] and NACE 6G197/SSPC-TU 2[28] for more information.

A1.1.4 When a significant amount of weak, deter-iorated, or contaminated concrete is removed during the course of surface preparation to achieve a sound surface, the profile of the remaining concrete is often too rough for the intended coating system. In these cases, and where form voids and bugholes must be filled, patching or grouting materials are specified to repair or level the concrete surface. See NACE Standard RP0892,[16] ACI 515.1R,[10] NACE Standard RP0390,[6] NACE 6G197/SSPC-TU 2,[28] and Para-graph A1.4.4 for more information about patching materials.

A1.2 Concrete Finishing and Surface Characteristics[24]

A1.2.1 The method used to finish concrete surfaces affects the concrete's surface profile, composition, porosity, and density. These surface properties affect the adhesion and performance of concrete coatings. Typical surface properties obtained using the most common finishing methods are given in Table A1. These properties are evaluated prior to surface preparation.

A1.2.2 No preferred method of finishing concrete to accept coatings has been established by the concrete coating industry. The surface cure, surface prepar-ation method, and type of coating system to be applied are all factors in determining the suitability of any specific concrete finishing method. For example, broom finishing is sometimes used because it gives a profile for the coating; however, most of the profile may be removed during surface preparation if the surface is not properly cured, negating this inherent advantage of the broom finish. When sacking is used to fill voids in formed concrete surfaces, subsurface voids are created, and the added cement is usually removed during surface preparation due to improper cure of the added cement paste.

A1.2.3 Use of a metal trowel is gaining acceptance as the preferred finishing method for horizontal surfaces to be coated, provided the surface is not excessively trowelled, the concrete is cured properly, and the laitance is removed prior to coating.

A1.2.4 Photographic examples of concrete finishes are shown in ASTM PCN:03-401079-14.[29]

A1.3 Concrete Cure[30]

A1.3.1 Maintaining sufficient moisture and proper temperature in concrete in the early stages of cure is important to ensure development of the designed strength. Keeping the surface moist until sufficient strength has developed at the surface is important to ensure formation of sufficient surface strength, to reduce curling, and to reduce surface cracking.

A1.3.2 ACI 308[5] recommends seven days of moist curing for Type I portland cement concrete and three days for Type III portland cement concrete, if the temperature is above 10°C (50°F). ACI 308 also recommends numerous methods to properly cure concrete, including the use of sealing materials and other methods to keep concrete moist.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE A1**
**Typical Surface Properties of Finished Concrete**

| Method | Profile[A] | Porosity[A] | Strength[A] | Problems |
|---|---|---|---|---|
| Formed concrete | Smooth to medium | Low to medium | Medium | Voids, protrusions, release agents |
| Wood float | Medium | Medium | Medium | |
| Metal trowel | Smooth | Low | High | |
| Power trowel | Smooth | Very low | High | Very dense |
| Broom finish | Coarse to very coarse | Medium | Medium | |
| Sacking | Smooth | Low to medium | Low to high[B] | Weak layer if not properly cured |
| Stoning | Smooth to medium | Low to medium | Low to high[B] | Weak layer if not properly cured |
| Concrete block | Coarse to very coarse | Very high | Medium | Pinholes |
| Shotcrete[C] | Very coarse | Medium | Medium | Too rough for thin coatings |

[A] These surface properties are based on similar concrete mix, placement, and vibration and prior to surface preparation.
[B] Strength depends on application and cure.
[C] Shotcrete may be refinished after placement, which would change the surface properties given in this table.

A1.3.3 ACI 308[5] also gives recommendations on the use of curing compounds, which are commonly used immediately after placement and finishing of concrete surfaces to reduce moisture loss and improve surface cure. The curing compound should either be compatible with the coating or be removed during surface preparation.

A1.4 Identification and Repair of Surface Defects and Damage[31]

A1.4.1 Physical and Chemical Damage

A1.4.1.1 Existing concrete structures that have been subjected to mechanical damage (due to impact or abrasion), chemical attack, or rebar corrosion are restored to provide a uniform, sound substrate prior to coating application.

A1.4.1.2 All deteriorated concrete should be removed and the surrounding sound concrete cut using the procedures described in ICRI 03730[7] in order to best receive and hold the patching material. Some contaminants will have a detrimental effect on the rebar or the applied coating if they are not completely removed.

A1.4.1.3 A number of polymeric grouts and patching materials can be used, especially when the coating is to be applied immediately. These materials should be compatible with the coating to be applied.

A1.4.2 Other Defects and Imperfections

A1.4.2.1 Defects such as honeycombs, scaling, and spalling do not provide a sound, uniform substrate for the coating. These defects are repaired by removing all unsound concrete and then patching the concrete prior to surface preparation. NACE Standard RP0390[6] and ICRI 03730[7] describe removal and repair procedures for concrete that is spalled due to rebar corrosion.

A1.4.2.2 Surface voids, bugholes, pinholes, or excessive porosity may affect the application or performance of the coating. The maximum substrate void size or surface porosity that can be tolerated depends on the coating system under consideration. If voids are not filled before the coating is applied, the trapped air vapor will expand and contract and may affect the performance of the coating. For liquid-rich coatings, excess porosity at the surface may result in pinholes in the coating. Voids are usually filled after surface preparation and prior to coating application.

Provided by : www.spic.ir Licensee: NISOC Library

A1.4.2.3 Protrusions such as form lines, fins, sharp edges, and spatter may cause holidays or thin sections in the coating if they are not removed. Protrusions and rough edges are usually removed during surface preparation.

A1.4.3 Testing for Surface Soundness

A1.4.3.1 NACE Publication 6G191[9] describes the following commonly used methods for determining surface soundness:

A screwdriver, file, or pocket knife is lightly scratched across the concrete surface. If the metal object rides over the surface without loosening any particles and leaves no more than a shiny mark, the surface is sound. If this process gouges the surface, the surface is not sound.

The concrete surface is lightly struck with the edge of a hammer head. If the hammer re-bounds sharply with no more than a small fracture at the impact area, the surface is sound. If it lands with a dull thud and leaves powdered dusts in the indentation, the surface is not sound.

A chain is dragged across horizontal concrete surfaces. Differences in sound indicate unsound concrete and holes or pockets within the concrete.

A1.4.4 Patching of Concrete Surface Imperfections

A1.4.4.1 Materials such as grouts, putties, and sealers are used to repair, patch, smooth, or seal the concrete surface to provide a substrate that is suitable for the coating system to be applied. These materials are applied after surface preparation and require the following characteristics:

(1) good adhesion;

(2) adequate strength;

(3) low volumetric and linear shrinkage;

(4) compatibility with the coating to be applied; and

(5) proper consistency for the application.

In addition, the patching material is often required to cure sufficiently, be traffic bearing, and be ready to recoat in a short time frame (usually within 24 hours).

A1.4.4.2 Shrinkage of the patching material may reduce the adhesion of that material to the concrete substrate. Differences in thermal expansion between the concrete, patching material, and coating system will cause stresses during thermally induced movement that may reduce adhesion between these layers.

A1.4.4.3 The most common types of patching materials are cementitious, polymer-modified cementitious (usually acrylic), and polymeric (usually epoxy). Cementitious materials are lower in cost than polymeric materials, but polymeric materials generally cure faster and have higher strengths, better adhesion, and increased chemical resistance.

A1.4.4.4 Patching materials are available in a range of consistencies for application to vertical or horizontal surfaces by a variety of methods. The amount of filler also varies. For example, grouts for deep patching are typically highly filled, while porosity sealers may be minimally filled or unfilled. Numerous proprietary materials are low shrinking, nonshrinking, or expanding.

A1.4.4.5 Additional surface preparation may need to be performed on cured patching materials to ensure that the laitance is removed and/or that the patched surface meets the profile requirements of the coating system.

A1.4.4.6 Photographic examples of patched concrete surfaces are shown in ASTM PCN:03-401079-14.[32]

A1.5 Identification and Removal of Contaminants [22,33,34,35]

A1.5.1 Hydrophobic Materials

A1.5.1.2 Hydrophobic materials such as form-release agents, curing compounds, sealers, existing coatings, oil, wax, grease, resins, and silicone may be detected by a simple water drop test. Analytical techniques such as infrared analysis or gas chromatography may also be used to detect and identify these contaminants.

A1.5.1.3 Oils and greases can be removed by steam cleaning, flame blasting, baking soda blasting, or using degreasers and absorbents.

A1.5.1.4 If they are incompatible with the coating to be applied, existing curing compounds, sealers, form-release agents, and coatings should be removed by the least destructive, most practical, economical, and safe method that is successful. Methods such as grinding, abrasive blasting, wet abrasive blasting, water jetting, scarifying, flame blasting, or paint stripping may be used.

A1.5.2 Salts and Reactive Materials

Provided by : www.spic.ir Licensee: NISOC Library

A1.5.2.1 Salts and reactive materials such as laitance, efflorescence, acids, alkalis, and by-products of chemical attack of concrete can sometimes be detected by pH testing, soundness testing using the screwdriver test, or visual examination (see PCA IS214.02T).[36] When these methods are not successful, chemical analysis techniques are required.

A1.5.2.2 Residual acids and alkalis are first neutralized and then removed by high-pressure water cleaning. Salts and efflorescence can be removed by abrasive blasting, high-pressure water cleaning, or applying a weak acid or alkali solution and then high-pressure water cleaning.

A1.5.3 Microorganisms

A1.5.3.1 Microorganisms such as fungus, moss, mildew, algae, decomposing foods, and other organic growths can sometimes be detected by visual examination (see PCA IS214.02T).[36]

A1.5.3.2 Microorganisms are removed by washing with sodium hypochlorite (household bleach) and rinsing with water. High-pressure water cleaning or abrasive blasting may also be used.

A1.6 Adhesion Testing[37]

Currently, no standard test method exists for determining the surface tensile strength of concrete or the adhesion of coatings to concrete. The two commonly used methods for testing adhesion of coatings to concrete substrates are ASTM D 4541[38] (modified for concrete substrates as discussed in Paragraph A1.6.1) and ACI 503R.[39] Testing for surface tensile strength consists of scoring (core drilling) the concrete surface, bonding a test fixture with an adhesive, pulling the fixture with an adhesion tester, and noting the pull-off strength or adhesion value. Testing for coating adhesion is performed using the same procedure, noting the adhesion value, and noting the adhesion failure mode (see Paragraph A1.6.4).

A1.6.1 The procedure described in ASTM D 4541[38] may be used to determine pull-off strength or coating adhesion strength using a portable adhesion tester, typically either a manual tester with a 20-mm (0.78-in.)-diameter loading fixture (test dolly) or a pneumatic adhesion tester with a 13-mm (0.5-in.) loading fixture. The 1993 version of ASTM D 4541 states that "Scoring around the fixture violates the fundamental in situ criterion that an unaltered coating be tested," but it also states that scoring should be noted in the results when employed.[40] The procedure in ASTM D 4541 should be modified for use on concrete substrates by scoring or core drilling prior to attaching the loading fixture. Scoring around the test fixture ensures that the pulling force is applied only to the area directly beneath the fixture. Without scoring, stress is transferred through the coating film beyond the area of the test fixture. This could result in significant error when testing thick or reinforced coatings. A water-lubricated diamond-tipped core bit should be used for scoring to reduce the possibility of microcracks in either the coating or the concrete substrate. The procedure may also be modified by using a larger (5-cm [2-in.] or more) loading fixture. A larger test fixture will typically yield more accurate results than a smaller fixture because the greater surface area reduces the effect of inconsistencies, such as a piece of aggregate or a void, in the substrate.

A1.6.2 ACI 503R[39] discusses the process of applying a coating or adhesive coring to the substrate, bonding a 5-cm (2-in.) pipe cap to the coating, and applying tension with a mechanical testing device attached to a dynamometer. As with ASTM D 4541,[38] the tensile load and mode of failure are noted.

A1.6.3 A test patch involves applying the coating system to a small section (with the minimum size to be specified) of prepared concrete and testing for tensile strength and adhesion by either of the methods described in Paragraphs A1.6.1 and A1.6.2. The prepared concrete substrate—at least the portion to be patched—should meet the acceptance criteria as detailed in Section 6. The coating system should be applied in accordance with the coating manufacturer's published instructions. The last coat of the coating system serves as the adhesive for the loading fixture, or, when this is not recommended (e.g., for solvent-based topcoats), the loading fixture is attached to the coating system by an adhesive. If agreed by all parties, the primer alone may suffice as the test patch and the adhesive for the loading fixture.

A1.6.4 The acceptable adhesion strength and mode of failure may vary depending on the type of coating tested. The coating manufacturer should be consulted to determine the preferred test method, the suitability of that method, and acceptance criteria for the specified coating. When adhesion testing is performed, the mode of failure should be noted. The failure can be described using one or more of the following terms.

(1) Concrete (substrate) cohesive failure: This failure mode is defined as failure within the concrete, below the concrete/coating interface. This result, if the adhesion value is sufficient, is considered to be the most desirable for coatings applied to concrete. If concrete cohesive failure occurs but the adhesion value is low, the failure may be due to low concrete strength or microcracking from scoring. If only a thin layer of concrete is pulled with the fixture and the adhesion value is low, it may be due to a weak concrete surface layer or laitance.

Provided by : www.spic.ir Licensee: NISOC Library

(2) Coating adhesive failure: This failure mode is defined as failure directly at the concrete/coating interface. For most coating systems, failure in this mode indicates a problem with surface preparation, residual contamination, or the coating.

(3) Coating cohesive failure or coating intercoat adhesion failure: This failure mode is defined as failure within the coating system, above the concrete/coating interface. This mode of failure indicates a problem with the coating material or with the coating application.

(4) Fixture adhesive failure: This failure mode is defined as failure within the fixture adhesive or at the fixture adhesive/coating interface. When this failure mode is encountered, the test should be repeated.

A1.7 Surface Profile

A1.7.1 In addition to removing laitance, weak concrete, and contamination at the concrete surface, surface preparation usually opens the pores and/or creates a profile on the concrete surface. Profile increases the surface area available for bonding between the concrete and the coating, enhances adhesion at the concrete/coating interface, and helps the coating resist peeling and shear forces.

A1.7.2 The depth of surface profile required depends on:

(1) tensile and shear strength of the concrete and the coating system;

(2) adhesion of the coating system to the concrete;

(3) internal stresses in the coating system created during application (e.g., from shrinkage);

(4) difference in the coefficient of thermal expansion between the coating and the concrete;

(5) modulus or stress-relaxation properties of the coating system;

(6) thermal and chemical exposure environment; and

(7) coating thickness.

A1.7.3 At this time, no recognized testing equipment or method is used to quantify the surface profile of concrete that is analogous to the replica tape method used on steel. The profile can be subjectively compared to the standard classification for coated abrasive paper as described in ANSI B74.18,[17] or by comparing the profile with the ICRI Guideline No. 03732[18] (surface profile chips). For extremely coarse prepared concrete surfaces (assuming that the coating system can cover and perform over such a substrate), the profile may be estimated as an average distance between peaks and valleys on the concrete surface and quantified in mm (mils).

A1.8 Moisture in Concrete[41,42,43,44]

A1.8.1 The movement of moisture in concrete during the curing process and after application of the coating is important to consider in the design of the concrete structure. Concrete is normally placed with water levels in excess of that required to completely hydrate the cement. Excess free water in the concrete can adversely affect the application and cure of many coatings. Pressure due to excess moisture in the concrete or from ground water may be substantial and, in some instances, may be sufficient to disbond barrier coating systems that appear to be well bonded. These pressures are com-monly referred to as hydrostatic, capillary, and osmotic pressures.

A1.8.2 Concrete has traditionally been coated no sooner than 28 days after concrete placement (see Paragraph A1.10). In addition to allowing the concrete to sufficiently cure (see Paragraph A1.3), this waiting period allows excess moisture to evaporate prior to applying a barrier coating system. The waiting period is especially important if a vapor barrier (or positive-side waterproofing) is installed, which prevents moisture from exiting into the ground.

A1.8.3 The drying rate of concrete is a function of the concrete temperature, thickness, porosity, and initial free-water content. The drying rate is also a function of the velocity and dew point of the drying air. Excess free water can be removed by dehumidifiers, surface air movers, or surface heaters provided that (1) the forced drying does not begin until sufficient concrete strength is developed and (2) it does not adversely affect the concrete properties. Dehumidifiers lower the air dew point, can increase the air temperature, and perform best when the area is enclosed. Surface air movers direct low-dew point air across the concrete surface at high velocities, but they should be periodically repositioned to ensure uniform drying over the entire surface. Surface heaters increase the mobility of free water; they work best if the heat penetrates the concrete and if they do not raise the dew point of the drying air.

A1.8.4 Moisture Test Methods[42,43]

The following are some of the common methods used to identify or quantify the free moisture in concrete prior to the application of coatings.

ASTM D 4263, Plastic sheet method.[20]

Calcium chloride test.[21]

Provided by : www.spic.ir Licensee: NISOC Library

BS(7) 5325, Hygrometer test (relative humidity method).[23]

BS 5325, Conductivity test (gel bridge method).[23]

Calcium carbide method.[21]

Capacitance-impedance method.[21]

A1.8.5 Use and Interpretation of Moisture Test Methods

A1.8.5.1 ASTM D 4263[20] and the calcium chloride test are commonly used and accepted in the United States. The hygrometer and conductivity tests are cited in numerous British standards and are accepted in the United Kingdom, while the carbide method is accepted in other parts of Europe.

A1.8.5.2 All of these methods are quantitative except ASTM D 4263.[20] The plastic sheet, calcium chloride, and capacitance-impedance methods are nondestructive, while the hygrometer, conductivity, and calcium carbide methods involve drilling into the concrete.

A1.8.5.3 Testing duration is 16+ hours for ASTM D 4263,[20] 72 hours for the calcium chloride method, and from 4 to 72 hours for the hygrometer test. The other methods give results immediately if the testing equipment has been calibrated.

A1.8.5.4 The plastic sheet method may indicate whether excess moisture is present at the time of the test. However, because the method depends on a moisture differential—a higher relative humidity in the concrete than in the air above the concrete surface—during the test span, potential problems are not always evident at the time the test is performed.

A1.8.5.5 Information on the tolerance of a specific coating system for free water or moisture migration should be provided by the coating manufacturer. A free water content of less than 5% by weight is acceptable for most coatings. Alternatively, concrete with a relative humidity of less than 80% or a moisture transmission rate of less than 15 g/24 hr/$m^2$ (3 lb/24 hr/1,000 $ft^2$) has proved acceptable for most coatings.

A1.8.5.6.Occasionally, despite moisture testing, a problem is not identified until after a low-permeability coating is applied.

(7) British Standards Institution (BSI), Two Park St., London, WIA 2BS, United Kingdom.

A1.9 Surface Preparation Methods[33,45,46,47]

The surface preparation methods described in this standard are listed in Table A2 with their intended use, profile created, typical problems encountered when using each method, and solutions to those problems.

A1.9.1 Photographic examples of prepared concrete surfaces are shown in ASTM PCN:03-401079-14.[48]

A1.10 The 28-Day Waiting Period[49,50]

A1.10.1 The traditional 28-day waiting period after concrete placement and prior to coating installation is a controversial topic that involves all parties. Although the waiting period is not usually required for surface preparation, it affects the timing of surface preparation because many coatings are applied within 24 hours after surface preparation.

A1.10.2 The 28-day waiting period originated from the structural benchmark to test concrete strength at 28 days after placement to verify that the tested strength met the design strength. The 28-day benchmark became the industry standard to identify the point in time when the concrete was considered fully cured. The 28-day waiting period was adopted by the coating industry because it usually allows sufficient time for concrete surface strength to develop and for excess moisture to evaporate.

A1.10.3 Many factors can reduce or increase the time required for strength and moisture levels to be acceptable. In addition, many construction schedules do not allow for a 28-day waiting period. For these reasons, quantifying surface requirements as in Paragraph A1.12 is preferred over the traditional 28-day waiting period.

A1.10.4NACE Standard RP0892[16] and ACI 515.1R[10] do not recommend a specific cure period but do address surface dryness, surface strength requirements, and other surface quality issues. NACE Standard RP0591[51] states that concrete normally requires a 28-day cure.

A1.11 Temperature Considerations

The temperature of the surface at the time of the coating application and the temperature progression during the application are both important. Rising concrete temperatures during the application of the coating systems may cause blistering and pinhole problems in the coating due to out-gassing from the concrete. Coating application during periods of falling temperatures may be required to prevent this problem.

Provided by : www.spic.ir Licensee: NISOC Library

Although controlling the ambient temperature in outdoor installations is difficult, concrete is often shaded from direct sunlight during coating application. In addition to potential problems from moisture in the concrete as described in Paragraphs A1.8.1 and A1.8.2, monitoring the dew point during periods of changing weather is often recommended to ensure that coatings are not applied over moisture that has condensed on the concrete surface.

**TABLE A2**
**Surface Preparation Methods**

| Preparation Method | When Used | Profile Created[A] | Problems | Solutions |
|---|---|---|---|---|
| Dry abrasive blasting | Removal, profile, cleaning | Fine (150) to extra coarse (40) | -Dust on surface<br>-Airborne dust<br>-Noise | -Vacuum cleaning<br>-Vacuum attachments<br>-None |
| Wet abrasive blasting | Removal, profile, cleaning | Fine (150) to extra coarse (40) | -Wets concrete<br>-Creates sludge | -Let concrete dry<br>-Cleaning |
| High-pressure water cleaning | Removal, cleaning | Fine (150) to extra coarse (40) | -Wets concrete<br>-Creates sludge | -Let concrete dry<br>-Cleaning |
| Water jetting (with or without abrasive) | Removal | Rougher than extra coarse | -Creates sludge<br>-Wets concrete<br>-Coarse profile | -Cleaning<br>-Let concrete dry<br>-None[B] |
| Impact tools | Removal, profile, cleaning | Rougher than extra coarse | -Airborne dust<br>-Fracturing<br>-Coarse profile | -Vacuum attachments<br>-Other methods<br>-None[B] |
| Power tools | Removal | Smooth (no grit equivalent) | -Airborne dust<br>-Fine profile | -Vacuum attachments<br>-Other methods |
| Flame blasting | Removal, profile, cleaning | Rougher than extra coarse | -Excess removal<br>-Damages concrete | -Experience[B]<br>-Remove damaged concrete |
| Acid etching | Profile, cleaning | Fine (150) to coarse (60) | -Hazardous<br>-Not for vertical or overhead surfaces<br>-Neutralization<br>-Wets concrete<br>-Curing membrane | -Other acids<br>-Other methods<br><br>-pH testing<br>-Let concrete dry<br>-Other methods |

[A] Profile is described using graded abrasive paper sizes. These are typical surface profile values only. Results may vary significantly due to concrete properties and surface preparation practices.
[B] For coating systems that will not perform over a coarse profile, refinishing the concrete or an underlayment may be required.

A1.12 Recommendations for Procurement Documents (Project Specifications) for Concrete Surface Preparation

Due to the wide range of concrete types, existing concrete conditions, ambient conditions, types of protective coatings to be applied, and project scheduling, producing a comprehensive standard that can be used as a project specification is not possible. Therefore, the following is a checklist of items that should be included in a comprehensive procurement document.

A1.12.1 SSPC-SP 13/NACE No. 6

A1.12.2 Contaminants

A1.12.2.1 Types anticipated

A1.12.2.2 Detection methods

A1.12.2.3 Preferred removal method

A1.12.2.4 Other acceptable removal methods

A1.12.3 Surface Preparation



Provided by : www.spic.ir Licensee: NISOC Library

A1.12.3.1 Preferred method

A1.12.3.2 Other acceptable methods

A1.12.4 Surface Tensile Strength

A1.12.4.1 Minimum allowable

A1.12.4.2 Test method and mode of failure

A1.12.5 Surface Profile

A1.12.5.1 Minimum and maximum allowable

A1.12.5.2 Test method or visual comparison

A1.12.6 Surface Uniformity

A1.12.6.1 Maximum allowable void size

A1.12.7 Repairs and Patching

A1.12.7.1 Preferred materials

A1.12.7.2 Other acceptable materials

A1.12.8 Cleanliness

A1.12.8.1 Maximum allowable residual dust level

A1.12.8.2 Test method or visual comparison

A1.12.9 Moisture Content

A1.12.9.1 Maximum allowable

A1.12.9.2 Test method and when to test (e.g., before or after surface preparation, or immediately before coating)

A1.12.10 Surface Flatness and Levelness

A1.12.10.1 Minimum and maximum slope allowed

A1.12.10.2 Minimum flatness allowed

A1.12.10.3 Test method or visual comparison

Provided by : www.spic.ir Licensee: NISOC Library

## Joint Surface Preparation Standard

# SSPC-SP 14/NACE No. 8

## Industrial Blast Cleaning

This SSPC: The Society for Protective Coatings and NACE International standard represents a consensus of those individual members who have reviewed this document, its scope and provisions. Its acceptance does not in any respect preclude anyone, having adopted the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not in conformance with this standard. Nothing contained in this standard is to be construed as granting any right, by implication or otherwise, to manufacture, sell, or use in connection with any method, apparatus, or product covered by Letters Patent, or as indemnifying or protecting anyone against liability for infringement of Letters Patent. This standard represents minimum requirements and should in no way be interpreted as a restriction on the use of better procedures or materials. Neither is this standard intended to apply in all cases relating to the subject. Unpredictable circumstances may negate the usefulness of this standard in specific instances. SSPC and NACE assume no responsibility for the interpretation or use of this standard by other parties and accept responsibility for only those official interpretations issued by SSPC or NACE in accordance with their respective governing procedures and policies, which preclude the issuance of interpretations by individual volunteers.

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

**CAUTIONARY NOTICE:** SSPC/NACE standards are subject to periodic review and may be revised or withdrawn at any time without prior notice. SSPC and NACE require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of initial publication. The user is cautioned to obtain the latest edition. Purchasers may receive current information on all standards and other publications by contacting the organizations at the addresses below.

© 1999, SSPC and NACE International

SSPC: The Society for Protective Coatings
40 24th Street, 6th Floor
Pittsburgh, PA 15222-4643
+1 (412) 281-2331

NACE International
P.O. Box 218340
Houston, TX 77218-8340
+1 (281) 228-6200

Provided by : www.spic.ir Licensee: NISOC Library

## Foreword

This joint standard covers the use of blast cleaning abrasives to achieve a defined degree of cleaning of steel surfaces prior to the application of a protective coating or lining system. This standard is intended for use by coating or lining specifiers, applicators, inspectors, or others whose responsibility it may be to define a standard degree of surface cleanliness.

The focus of this standard is industrial blast cleaning. White metal blast cleaning, near-white blast cleaning, commercial blast cleaning, and brush-off blast cleaning are addressed in separate standards.

Industrial blast cleaning provides a greater degree of cleaning than brush-off blast cleaning (SSPC-SP 7/NACE No. 4), but less than commercial blast cleaning (SSPC-SP 6/NACE No. 3).

Industrial blast cleaning is used when the objective is to remove most of the coating, mill scale, and rust, but when the extra effort required to remove every trace of these is determined to be unwarranted.

The difference between an industrial blast and a brush-off blast is that the objective of a brush-off blast is to allow as much of an existing coating to remain as possible, while the purpose of the industrial blast is to remove most of the coating.

A commercial blast is free of mill scale, rust, and coatings, and allows only random staining on less than 33% of the surface. The industrial blast allows defined mill scale, coating, and rust to remain on less than 10% of the surface and allows defined stains to remain on all surfaces.

This joint standard was prepared by the SSPC/NACE Task Group A on Surface Preparation by Abrasive Blast Cleaning. This joint Task Group includes members of both the SSPC Surface Preparation Committee and the NACE Unit Committee T-6G on Surface Preparation.

## 1. General

**1.1** This joint standard covers the requirements for industrial blast cleaning of unpainted or painted steel surfaces by the use of abrasives. These requirements include the end condition of the surface and materials and procedures necessary to achieve and verify the end condition.

**1.2** This joint standard allows defined quantities of mill scale and/or old coating to remain on the surface.

**1.3** The mandatory requirements are described in Sections 1 to 9 as follows:

Section 1 General

Section 2 Definition

Section 3 References

Section 4 Procedure Before Blast Cleaning

Section 5 Blast Cleaning Methods and Operation

Section 6 Blast Cleaning Abrasives

Section 7 Procedures Following Blast Cleaning and Immediately Prior to Coating

Section 8 Inspection

Section 9 Safety and Environmental Requirements

NOTE: Section 10, “Comments” and Appendix A, “Explanatory Notes” are not mandatory requirements of this standard.

## 2. Definition

**2.1** An industrial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dust, and dirt. Traces of tightly adherent mill scale, rust, and coating residues are permitted to remain on 10% of each unit area of the surface (see Section 2.6) if they are evenly distributed. The traces of mill scale, rust, and coating shall be considered tightly adherent if they cannot be lifted with a dull putty knife. Shadows, streaks, and discolorations caused by stains of rust, stains of mill scale, and stains of previously applied coating may be present on the remainder of the surface.

**2.2** The shape, configuration, and design of structures can lead to areas of limited accessibility for blast cleaning. Examples include crevices around rivets or fasteners, and behind or between tightly configured back-to-back angles. Because of the limited accessibility, these areas are exempt from the 10% restrictions established in Section 2.1. However, all surfaces in limited-access areas shall be subjected to the abrasive blast, and upon completion, old coating, rust, and mill scale are permitted to remain provided they are well-adherent as determined using a dull putty knife.

**2.3** Acceptable variations in appearance that do not affect surface cleanliness as defined in Section 2.1 include variations caused by type of steel, original surface condition, thickness of the steel, weld metal, mill or fabrication marks, heat treating, heat affected zones, blasting abrasives, and differences due to blasting technique.

**2.4** When a coating is specified, the surface shall be roughened to a degree suitable for the specified coating system.

**2.5** Immediately prior to coating application, the surface shall comply with the degree of cleaning specified herein.

Provided by : www.spic.ir Licensee: NISOC Library

**2.6** Unit area for determinations shall be approximately 5776 $mm^2$ (9 $in^2$) (i.e., a square 76 mm x 76 mm [3 in x 3 in]).

**2.7** ISO 8501-1:(latest edition)/SS 05 59 00(1) (Condition B Sa 2), or other visual standards of surface preparation may be specified to supplement the written definition.

NOTE: Additional information on visual standards is available in Section A.4 of Appendix A. Also note that Condition B Sa 2 of ISO 8501-1 does not depict the influence that previously applied coating may have on the appearance of the prepared surface. It is based on the preparation of a previously uncoated steel surface covered with rust and flaking mill scale.

## 3. References

**3.1** The standards referenced in this standard are listed in Sections 3.4 and 3.5.

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

**3.3** If there is a conflict between the requirements of any of the cited reference standards and this standard, the requirements of this standard shall prevail.

**3.4 SSPC: THE SOCIETY FOR PROTECTIVE COATINGS STANDARDS:**

| | |
|---|---|
| **AB 1** | Mineral and Slag Abrasives |
| **AB 2** | Cleanliness of Recycled Ferrous Metallic Abrasives |
| **AB 3** | Newly Manufactured or Re-Manufactured Steel Abrasives |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **SP 1** | Solvent Cleaning |

**3.5 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO) STANDARD:**

| | |
|---|---|
| **ISO 8501-1:1988 /SS 05 59 00** | Preparation of steel substrates before application of coatings and related products—Visual assessment of surface cleanliness |

## 4. Procedures Before Blast Cleaning

**4.1** Before blast cleaning, visible deposits of oil, grease, or other contaminants shall be removed in accordance with SSPC-SP 1 or other agreed-upon methods.

**4.2** Before blast cleaning, surface imperfections such as sharp fins, sharp edges, weld spatter, or burning slag should be removed from the surface to the extent required by the procurement documents (project specification).

NOTE: Additional information on surface imperfections is available in Section A.5 of Appendix A.

**4.3** If a visual standard or comparator is specified to supplement the written standard, the condition of the steel prior to blast cleaning should be determined before the blasting commences.

NOTE: Additional information on visual standards and comparators is available in Section A.4 of Appendix A.

## 5. Blast Cleaning Methods and Operation

**5.1** Clean, dry compressed air shall be used for nozzle blasting. Moisture separators, oil separators, traps, or other equipment may be necessary to achieve this requirement.

**5.2** Any of the following methods of surface preparation may be used to achieve an industrial blast cleaned surface:

**5.2.1** Dry abrasive blasting using compressed air, blast nozzles, and abrasive.

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

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

**5.3** Other methods of surface preparation (such as wet abrasive blasting) may be used to achieve an industrial blast cleaned surface by mutual agreement between those responsible for performing the work and those responsible for establishing the requirements.

NOTE: Information on the use of inhibitors to prevent the formation of rust immediately after wet blast cleaning is contained in Section A.9 of Appendix A.

## 6. Blast Cleaning Abrasives

**6.1** The selection of abrasive size and type shall be based on the type, grade, and surface condition of the steel to be cleaned, type of blast cleaning system employed, the finished surface to be produced (cleanliness and roughness), and whether the abrasive will be recycled.

(1) ISO 8501-1: (latest edition)/SS 05 59 00 is available from the Swedish Standards Institute (Standardisering-kommissionen i Sverige—SIS), Box 6455, S 113-92 Stockholm, Sweden, and SSPC: The Society for Protective Coatings, 40 24th Street, 6th Floor, Pittsburgh, PA 15222-4656, USA.

Provided by : www.spic.ir Licensee: NISOC Library

**6.2** The cleanliness and size of recycled abrasives shall be maintained to ensure compliance with this specification.

**6.3** The blast cleaning abrasive shall be dry and free of oil, grease, and other contaminants as determined by the test methods found in SSPC-AB 1, SSPC-AB 2 and SSPC-AB 3.

**6.4** Any limitations on the use of specific abrasives, the quantity of contaminants, or the degree of allowable embedment shall be included in the procurement documents (project specification) covering the work, because abrasive embedment and abrasives containing contaminants may not be acceptable for some service requirements.

NOTE: Additional information on abrasive selection is given in Section A.2 of Appendix A.

## 7. Procedures Following Blast Cleaning and Immediately Prior to Coating

**7.1** Visible deposits of oil, grease, or other contaminants shall be removed according to SSPC-SP 1 or another method agreed upon by those parties responsible for establishing the requirements and those responsible for performing the work.

**7.2** Dust and loose residues shall be removed from prepared surfaces by brushing, blowing off with clean, dry air, vacuum cleaning, or other methods agreed upon by those responsible for establishing the requirements and those responsible for performing the work.

NOTE: The presence of toxic metals in the abrasives or paint being removed may place restrictions on the methods of cleaning permitted. Moisture separators, oil separators, traps, or other equipment may be necessary to achieve clean, dry air.

**7.3** After blast cleaning, surface imperfections that remain (e.g., sharp fins, sharp edges, weld spatter, burning slag, scabs, slivers, etc.) shall be removed to the extent required in the procurement documents (project specification). Any damage to the surface profile resulting from the removal of surface imperfections shall be corrected to meet the requirements of Section 2.4.

NOTE: Additional information on surface imperfections is contained in Section A.5 of Appendix A.

**7.4** Any visible rust that forms on the surface of the steel after blast cleaning shall be removed by recleaning the rusted areas to meet the requirements of this standard before coating.

NOTE: Information on rust-back (re-rusting) and surface condensation is contained in Sections A.6, A.7, and A.8 of Appendix A.

## 8. Inspection

**8.1** Work and materials supplied under this standard are subject to inspection by a representative of those responsible for establishing the requirements. Materials and work areas shall be accessible to the inspector. The procedures and times of inspection shall be as agreed upon by those responsible for establishing the requirements and those responsible for performing the work.

**8.2** Conditions not complying with this standard shall be corrected. In the case of a dispute, an arbitration or settlement procedure established in the procurement documents (project specification) shall be followed. If no arbitration or settlement procedure is established, then a procedure mutually agreeable to purchaser and supplier shall be used.

**8.3** The procurement documents (project specification) should establish the responsibility for inspection and for any required affidavit certifying compliance with the specification.

## 9. Safety and Environmental Requirements

**9.1** Because abrasive blast cleaning is a hazardous operation, all work shall be conducted in compliance with applicable occupational and environmental health and safety rules and regulations.

NOTE: SSPC-PA Guide 3, “A Guide to Safety in Paint Application,” addresses safety concerns for coating work.

## 10. Comments

**10.1** Additional information and data relative to this standard are contained in Appendix A. Detailed information and data are presented in a separate document, SSPC-SP COM, “Surface Preparation Commentary.” The recommendations contained in Appendix A and SSPC-SP COM are believed to represent good practice, but are not to be considered requirements of the standard. The sections of SSPC-SP COM that discuss subjects related to industrial blast cleaning are listed below.

| Subject | Commentary Section |
|---|---|
| Abrasive Selection | 5 |
| Degree of Cleaning | 11.6 |
| Film Thickness | 10 |
| Wet Abrasive Blast Cleaning | 9 |

Provided by : www.spic.ir Licensee: NISOC Library

Maintenance Repainting ..... 3.2
Rust-back (Re-rusting) ..... 8
Surface Profile ..... 6
Visual Standards ..... 7
Weld Spatter ..... 4.1

## Appendix A. Explanatory Notes

**A.1 FUNCTION:** Industrial blast cleaning (SSPC-SP 14/NACE No. 8) provides a greater degree of cleaning than brush-off blast cleaning (SSPC-SP 7/NACE No. 4), but less than commercial blast cleaning (SSPC-SP 6/NACE No. 3). It should be specified only when a compatible coating will be applied. The primary functions of blast cleaning before coating are: (a) to remove material from the surface that can cause early failure of the coating system and (b) to obtain a suitable surface roughness and to enhance the adhesion of the new coating system. The hierarchy of blasting standards is as follows: white metal blast cleaning, near-white blast cleaning, commercial blast cleaning, industrial blast cleaning, and brush-off blast cleaning.

**A.2 ABRASIVE SELECTION:** Types of metallic and non-metallic abrasives are discussed in the Surface Preparation Commentary (SSPC-SP COM). It is important to recognize that blasting abrasives may become embedded in or leave residues on the surface of the steel during preparation. While normally such embedment or residues are not detrimental, care should be taken to ensure that the abrasive is free from detrimental amounts of water-soluble, solvent soluble, acid-soluble, or other soluble contaminants (particularly if the prepared steel is to be used in an immersion environment). Criteria for selecting and evaluating abrasives are given in SSPC-AB 1, "Mineral and Slag Abrasives," SSPC-AB 2, "Cleanliness of Recycled Ferrous Metallic Abrasives," and SSPC-AB 3, "Newly Manufactured or Re-Manufactured Steel Abrasives."

**A.3 SURFACE PROFILE:** Surface profile is the roughness of the surface which results from abrasive blast cleaning. The profile depth (or height) is dependent upon the size, shape, type, and hardness of the abrasive, particle velocity and angle of impact, hardness of the surface, amount of recycling, and the proper maintenance of working mixtures of grit and/or shot.

The allowable minimum/maximum height of profile is usually dependent upon the thickness of the coating to be applied. Large particle sized abrasives (particularly metallic) can produce a profile that may be too deep to be adequately covered by a single thin film coat. Accordingly, it is recommended that the use of larger abrasives be avoided in these cases. However, larger abrasives may be needed for thick film coatings or to facilitate removal of thick coatings, heavy mill scale, or rust. If control of profile (minimum/maximum) is deemed to be significant to coating performance, it should be addressed in the procurement documents (project specification). Typical maximum profile heights achieved with commercial abrasive media are shown in Table 8 of the Surface Preparation Commentary (SSPC-SP COM). Surface profile should be measured in accordance with NACE Standard RP0287 (latest edition), "Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using Replica Tape," or ASTM D 4417[(2)] (latest edition), "Test Method for Field Measurement of Surface Profile of Blast Cleaned Steel."

**A.4 VISUAL STANDARDS:** ISO 8501-1:(latest edition)/ SIS SS 05 59 00, Photograph BSa2, depicts the appearance of a surface that is consistent with the definition of an industrial blast.

**A.5 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 that are difficult to properly cover and protect include crevices, weld porosities, laminations, etc. The high cost of the methods to remedy 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 blast cleaning operation. Other surface defects (steel laminations, weld porosities, or deep corrosion pits) may not be evident until the surface preparation has been completed. Therefore, proper planning for such surface repair work is essential because the timing of the repairs may occur before, during, or after the blast cleaning operation. Section 4 of SSPC-SP COM and NACE Standard RP0178 (latest edition), "Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service" contain additional information on surface imperfections.

**A.6 CHEMICAL CONTAMINATION:** Steel contaminated with soluble salts (e.g., chlorides and sulfates) develops rust-back rapidly at intermediate and high humidities. These soluble salts can be present on the steel surface prior to blast cleaning as a result of atmospheric contamination. In addition, contaminants can be deposited on the steel surface during blast cleaning if the abrasive is contaminated. Therefore, rust-back can be minimized by removing these salts from the steel surface, and eliminating sources of recontamination during and after blast cleaning. Wet methods of removal are described in SSPC-SP 12/NACE No. 5. Identification of the contaminants along with their concentrations may be obtained from laboratory and field tests as described in SSPC-TU 4, "Technology

(2) Available from ASTM (American Society for Testing and Materials), 100 Barr Harbor Drive, West Conshohocken PA 19428-2959, USA.

Provided by : www.spic.ir Licensee: NISOC Library

Update on Field Methods for Retrieval and Analysis of Soluble Salts on Substrates."

**A.7 RUST-BACK:** Rust-back (re-rusting) occurs when freshly cleaned steel is exposed to moisture, contamination, or a corrosive atmosphere. The time interval between blast cleaning and rust-back will vary greatly from one environment to another. Under mild ambient conditions, if chemical contamination is not present (see Section A.6), it is best to blast clean and coat a surface the same day. Severe conditions may require more expedient coating application to avoid contamination from fallout. Chemical contamination should be removed prior to coating (see Section A.6).

**A.8 DEW POINT:** Moisture condenses on any surface that is colder than the dew point of the surrounding air. It is, therefore, recommended that the temperature of the steel surface be at least 3 °C (5 °F) above the dew point during dry blast cleaning operations. It is advisable to visually inspect for moisture and periodically check the surface temperature and dew point during blast cleaning operations and to avoid the application of coating over a damp surface.

**A.9 WET ABRASIVE BLAST CLEANING:** Steel that is wet abrasive blast cleaned may rust rapidly. Clean water should be used for rinsing. It may be necessary that inhibitors be added to the water or applied to the surface immediately after blast cleaning to temporarily prevent rust formation. The use of inhibitors or the application of coating over slight discoloration should be in accordance with the requirements of the coating manufacturer. CAUTION: Some inhibitive treatments may interfere with the performance of certain coating systems.

**A.10 FILM THICKNESS:** It is essential that ample coating be applied after blast cleaning to adequately cover the peaks of the surface profile. The dry film thickness of the coat-ng above the peaks of the profile should equal the thickness known to be needed for the desired protection. If the dry film thickness over the peaks is inadequate, premature rust-through or failure will occur. To assure that coating thicknesses are properly measured the procedures in SSPC-PA 2 (latest edition), "Measurement of Dry Coating Thickness with Magnetic Gauges" should be used.

**A.11 MAINTENANCE AND REPAIR PAINTING:** When this standard is used in maintenance painting, specific instructions should be given on the extent of surface to be blast cleaned or spot blast cleaned to this degree of cleanliness. In these cases, the cleaning shall be performed across the entire area specified. For example, if all weld seams are to be cleaned in a maintenance operation, this degree of cleaning shall be applied 100% to all weld seams. If the entire structure is to be prepared, this degree of cleaning shall be applied to 100% of the entire structure. SSPC-PA Guide 4 (latest edition), "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," provides a description of accepted practices for retaining old sound coating, removing unsound coating, feathering, and spot cleaning.

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC-TR 1/NACE 6G194

# INFORMATIONAL REPORT AND TECHNOLOGY UPDATE

## Thermal Pre-Cleaning

NACE International (NACE) and SSPC: The Society for Protective Coatings (SSPC) issue this technical committee report in conformance with the best current technology regarding the specific subject. This technical committee report represents a consensus of those individual members who have reviewed this document, its scope, and provisions. It is intended to aid the manufacturer, the consumer, and the general public. Its acceptance does not in any respect preclude anyone, whether he has adopted the report or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not addressed in this report. Nothing contained in this NACE/SSPC technical committee report is to be construed as granting any right, by implication or otherwise, to manufacture, sell, or use in connection with any method, apparatus, or product covered by Letters Patent, or as indemnifying or protecting anyone against liability for infringement of Letters Patent. This technical committee report represents current technology and should in no way be interpreted as a restriction on the use of better procedures or materials. Neither is this report intended to apply in all cases relating to the subject. Unpredictable circumstances may negate the usefulness of this technical committee report in specific instances. NACE and SSPC assume no responsibility for the interpretation or use of this technical committee report by other parties and accept responsibility for only those official interpretations issued by NACE or SSPC in accordance with their governing procedures and policies which preclude the issuance of interpretations by individual volunteers.

Users of this technical committee report are responsible for reviewing appropriate health, safety, and regulatory documents and for determining their applicability in relation to this report prior to its use. This NACE/SSPC technical committee report may not necessarily address all safety problems and hazards associated with the use of materials, operations, and/or equipment detailed or referred to within this document.

CAUTIONARY NOTICE: NACE/SSPC technical committee reports are subject to periodic review, and may be revised or withdrawn at any time without prior notice. The user is cautioned to obtain the latest edition. NACE and SSPC require that action be taken to reaffirm, revise, or withdraw this technical committee report no later than five years from the date of initial publication.

Approved October 1994
Copyright (c)1994, NACE International and SSPC

NOTICE TO THE READER: The NACE and SSPC releases of this publication contain identical wording in the same sequence. Publication format may differ.

SSPC: The Society for Protective Coatings
40 24th Street, Sixth Floor
Pittsburgh, PA 15222
+1 412-281-2331

NACE International
P.O. Box 218340
Houston, TX 77218-8340
+1 218 281-6200
Printed by SSPC

### Foreword

Although thermal precleaning has long been a standard procedure in the oil and gas industry as a method of surface preparation for the application of high-bake coatings to the interior surfaces of oilfield tubular goods,[1] it is now commonly used in the process industry as well. The surfaces of tanks, rail tank cars, tubular goods, and process equipment that have been exposed to a corrosive environment are usually pitted and scaled and contain chemical contaminants both on the surface and within the grain boundaries of the substrate. Failure to remove deleterious amounts of these contaminants ultimately results in blistering and premature failure of the coating.[2] Years of industry experience have shown that abrasive blasting alone will not adequately remove all contaminants, especially in the bottom of pits.

Thermal precleaning is not used exclusively; rather, it is a surface preparation method that, when used in conjunction with other cleaning methods, can achieve the degree of cleanliness required for a successful coating application. Thermal precleaning is typically used in conjunction with abrasive blasting, high-pressure water cleaning, steaming, chemical treatment (e.g., phosphoric acid), or several repetitive applications of thermal precleaning and abrasive blasting in order to facilitate the removal of deleterious levels of salts and carbonaceous materials produced as a result of thermal precleaning.

Within industry there is sufficient experience with thermal precleaning, particularly by coating application shops, to warrant the issuance of this state-of-the-art report by means of which industry can refer to a consensus document for thermal precleaning in coating specifications.

Provided by : www.spic.ir Licensee: NISOC Library

This state-of-the-art report was prepared by NACE/SSPC Task Group B on Surface Preparation by Thermal Cleaning,[3] which is a component of NACE Unit Committee T-6G on Surface Preparation for Protective Coatings and the SSPC Surface Preparation Committee. This report is issued by NACE International under the auspices of Group Committee T-6 on Protective Coatings and Linings and by SSPC: The Society for Protective Coatings.

## General

This state-of-the-art report addresses the use of thermal precleaning for tanks, vessels, rail tank cars and hopper cars, and process equipment when preparing surfaces for the application of high-performance or high-bake coating and lining systems.

## Definitions

**Thermal Precleaning:** Thermal precleaning is the application of high temperatures to aid in the partial or complete degradation, embrittlement, and/or dilution and subsequent removal of contaminants and failed or old coatings from the surface of a substrate prior to abrasive blast cleaning and coating application. Dry heat and wet heat are two common types of thermal precleaning.

**Dry Heat:** The structure to be thermally precleaned is subjected to elevated temperatures by appropriate means, such as an oven, in order to: (1) thermally degrade wax, grease, oil, tar, drawing compounds (if the proper temperatures are achieved), and some hydrocarbon-based volatiles; and (2) embrittle existing coatings to facilitate their removal from ferrous and nonferrous substrates. Thermal precleaning removes all volatile contaminants from the substrate that might otherwise come out during the curing process and result in blistering of the coating.

**Wet Heat:** The structure to be thermally precleaned is heated to elevated temperatures by steam (pressurized or unpressurized) for the purpose of diluting and removing salts of oxidizing acids such as nitric and sulfuric acid, mineral acids such as hydrochloric acid, alkalies, and other chemical contaminants such as sulfates and chlorides that either reside on or have permeated the grain boundaries of ferrous and non-ferrous surfaces.

## Preparation for Thermal Precleaning

All heavy deposits of wax, grease, oil, etc., some of which may autoignite when heated, are typically removed in accordance with SSPC-SP 1, "Solvent Cleaning."[3] Heavy rust scale, nodules, tubercles, and other encrusted contaminants can be removed prior to thermal precleaning in order to facilitate removal of embedded contaminants. The methods of removal include abrasive blasting (such as NACE No. 4/SSPC-SP 7[4]), water blasting or water jetting (in accordance with NACE Standard RP0172[5]), or mechanical means such as hand or power tool cleaning (in accordance with SSPC-SP 2,[6] or SSPC-SP 3[7]).

## Application of Thermal Precleaning

Thermal precleaning is time and temperature related. Previous experience is generally the governing factor in the length of time required to effectively remove deleterious amounts of contaminants from the substrate. The specific temperature and duration of the heat application vary with the heat method, type of contaminant, substrate material, and complexity of substrate configuration.

CAUTION: Some exterior paints or other components (such as alloys, wooden bolsters, elastomeric materials in valves, gasket materials, etc.) of the item being heated may be altered or adversely affected by the applied temperature. Some compounds/chemicals that are in contact with the substrate may cause stress corrosion cracking in welds and base metals, and more elaborate testing/inspection is typically performed in these cases. The item to be thermally precleaned is typically inspected for stress corrosion cracking before precleaning, if possible, or before lining application if base metal is obscured by existing linings or corrosion deposits. Thermal precleaning is not intended for use in the removal of hydrogen in steel.

---

(1)Thermal precleaning procedures for the oilfield tubular goods are a special case requring higher temperature ranges for adequate degradation. For specific information on these procedures, refer to NACE Standard RP0191(latest revision), "The Application of Internal Plastic Coatings for Oilfield Tubular Goods and Accessories."[1]

(2)Trimber cites the most commonly used contemporary methods for detecting contaminants and then lists the most recent and generally industry-accepted levels of residual contaminants that will not adversely affect coating performance.[2] The list includes the following information:

1. Weldon, et. al., whose laboratory work indicates that chloride levels need to be less than 5 $\mu g/cm^2$ and sulfate levels less than 10 $\mu g/cm^2$.
2. Swedish Corrosion Institute, studies indicate levels less than 2 $\mu g/cm^2$ and 10 $\mu g/cm^2$ respectively.
3. British Maritime studies indicate levels less than 7 $\mu g/cm^2$ and 16 $\mu g/cm^2$ respectively.
4. When coating thickness exceeds 250 $\mu m$ (10 mils), the tolerance level appears to be good at concentrations up to 50 $\mu g/cm^2$ for both types of contaminants.
5. The conclusion is that the data indicates levels of chloride contamination on the order of 2 to 10 $\mu g/cm^2$ and sulfate contamination on the order of 10 to 20 $\mu g/cm^2$ can adversely affect the performance of most coatings.
   The bibliography lists other articles that address this subject.

(3) Chaired by the late Carroll Steely, formerly with Vickers Industrial Coatings, Lyons, Texas.

Provided by : www.spic.ir Licensee: NISOC Library

**Dry Heat**

Thermal precleaning using dry heat may degrade or char existing coatings and/or remove some contaminants from the surfaces of tanks, vessels, piping, and other hydrocarbon-contaminated surfaces. Oven temperatures are typically 232 to 426 °C (450 to 800 °F). Under certain conditions lower temperatures are sometimes used; general practice is that the thermal precleaning temperature be a minimum of 28 °C (50 °F) above the curing temperature of the coating to be applied or the operating temperature of the equipment. When high-bake coatings are to be applied to a contaminated structure, the structure is thermally precleaned at a temperature in excess of the final bake temperature of the coating being applied. This procedure ensures that contaminants whose volatile temperatures are at or near the final bake temperature of the coating will have been released and will not interfere with the final cure and integrity of the coating being applied. General practice has been that the dwell time of the thermal precleaning heat exceed the final cure time of the previously applied coating by a minimum of 30 minutes.

Since ovens are not always practical when working with large equipment, an alternative method of thermal precleaning is to insulate the tank or vessel and use ducts to convey heat into the vessel from portable, non-contaminating natural gas or LPG heaters, thereby raising the temperature of the metal substrate to the desired thermal precleaning temperature.

Decomposition of organic materials is related to time and temperature. Thermal precleaning proceeds slowly with a gradual rise in temperature until the metal substrate is evenly heated to the desired temperature. The decomposition time period begins when this temperature is reached and continues for as long as necessary to achieve partial or complete decomposition of organic contaminants.

Salt deposits and carbonaceous residues are typically removed using high-temperature steam or a hot-water rinse prior to abrasive blasting.

**Wet Heat**

Thermal precleaning using high-temperature steam dilutes acid salts, fatty acids, alkalies, waxes, and other water-soluble contaminants so that they are more readily removed by high-pressure water cleaning. Wet heat (steam) is also used to remove grease and oil in accordance with SSPC-SP 1, "Solvent Cleaning." Steam tables list the pressures used to achieve the desired thermal precleaning temperature. Only pressure-rated structures are subjected to pressurized thermal precleaning steam temperatures. Nonpressure-rated vessels are typically isolated, vented, and insulated before and during the injection of steam. This procedure ensures that the injected steam will be able to sustain a substrate temperature at or near 100 °C (212 °F), usually 93 °C (200 °F).

Because wet heat is usually applied at a lower temperature than dry heat, longer dwell times are generally used, particularly when contaminants are embedded in grain boundaries[4] or the bottom of pits or craters. With severe cases of grain-boundary or pit contamination, repeated applications of wet heat and abrasive blasting are often used to remove deleterious levels of contaminants such that the surface will not immediately discolor after abrasive blasting.

Abrasive blasting is typically performed after thermal precleaning operations are completed.

## Verification of Surface Cleanliness After Thermal Precleaning

The most common method used by many coatings applicators to determine surface cleanliness is to observe the prepared surface and carefully note any rapid discoloration. Rapid discoloration indicates that contaminants remain on the surface. This method is not effective in dry environments because moisture is not present to react with contaminants that may remain on the surface. Test kits for detecting the presence of visible and/or nonvisible contaminants are commercially available for use in the field; several published references and test methods are cited in Table 1 and the bibliography.

## Specific Applications

Thermal precleaning is a valuable aid in the removal of pre-existing coatings that might be time- and cost-prohibitive to remove by conventional abrasive blast cleaning. When charred by thermal precleaning, most coatings lose their adhesion so that abrasive blasting more readily removes them.

Oilfield tubular lining shops employ thermal precleaning as a means of volatilizing grease, oils, waxes, and other contaminants that might otherwise be released during the baking and curing cycle of high-bake thermoset coatings and cause blistering of the applied coating.

A commonly accepted practice is to thermally preclean oilfield tubular goods at 371 to 426 °C (700 to 800 °F) for four to six hours after the metal reaches the desired temperature in order to thermally degrade oil, grease, wax, old coatings, and other organic contaminants encountered in the oil and gas industry.[8]

[4] "In a severe case of grain-boundary corrosion, entire grains are dislodged due to complete deterioration of their boundaries. In such a case, the surface will appear rough to the naked eye and will feel sugary because of the loose grains." Source: M. Henthorne, "Fundamentals of Corrosion," Chemical Engineering 78, 11 (1971): p. 131.

Provided by : www.spic.ir Licensee: NISOC Library

Some companies successfully treat chloride-contaminated oilfield tubular goods by performing the following: (1) abrasive blast, (2) preheat to 66°C (150 °F), (3) phosphoric acid wash, (4) rinse with water, and (5) reblast.[9, 10]

Process industry lining shops use thermal precleaning in their work with: (1) process tanks, especially chemical process and storage tanks, that have old or failed linings and require reapplication; (2) unlined tanks and equipment that have suffered metal loss and pitting and now require a lining to provide extended service; and (3) equipment that has become chemically contaminated during storage, shipment, or fabrication.

In the power industry, wet heat followed by a hydrogen peroxide rinse has been used to disinfect water boxes that have pitted and corroded due to microbiologically induced corrosion (MIC).[11]

Mill varnish on pipe has been removed successfully by thermal precleaning at 288 °C (550 °F) held for one hour, although thermal precleaning at 260 °C (500 °F) for the same period of time has not achieved the desired results.

Some owners of rail tank cars (e.g., cars used to transport sulfuric acid) have the cars first neutralized with a 10% caustic solution then subjected to high heat (232°C [450°F]) to thermally degrade organic contaminants. Chloride and sulfate contaminants are removed by high-pressure water jetting followed by abrasive blasting.[12]

Steam cleaning helps remove chlorides and sulfates. Frondistou-Yannas concludes that, "In terms of effectiveness in removing chlorides and sulfates from a rusted steel surface, the methods of surface preparation rank as follows: (1) Water blasting; (2) steam, detergent, and wire-brushing; (3) solvent cleaning and wire-brushing; and (4) single wire-brushing."[13]

## Testing for Surface Contaminants

Table 1 lists candidate physical or chemical tests for the presence of contaminants that still may be present on cleaned steel. The International Organization for Standardization (ISO)[(5)] has drafted documents that, if approved, may replace the cited standards. Although no U.S. standards exist for physical and chemical testing, NACE Publication 6G186, "Surface Preparation of Contaminated Steel Surfaces,"[14] gives additional information on currently available field tests for detecting contaminants.

## References

1. NACE Standard RP0191 (latest revision), "The Application of Internal Plastic Coatings for Oilfield Tubular Goods and Accessories" (Houston, TX: NACE International).
2. K.A. Trimber, "Detection and Removal of Chemical Contaminants in Pulp and Paper Mills," Journal of Protective Coatings and Linings 5, 11 (1988): pp. 30-37.
3. SSPC-SP 1 (latest revision), "Solvent Cleaning" (Pittsburgh, PA: SSPC).
4. NACE No. 4/SSPC-SP 7 (latest revision), "Brush-Off Blast Cleaning" (Houston, TX: NACE International and Pittsburgh, PA: SSPC).
5. NACE Standard RP0172 (latest revision), "Surface Preparation of Steel and Other Hard Material by Water Blasting Prior to Coating or Recoating" (Houston, TX: NACE International).
6. SSPC-SP 2 (latest revision), "Hand Tool Cleaning" (Pittsburgh, PA: SSPC).
7. SSPC-SP 3 (latest revision), "Power Tool Cleaning" (Pittsburgh, PA: SSPC).
8. NACE Standard RP0181 (latest revision), "Liquid Applied Internal Protective Linings and Coatings for Oilfield Production Equipment'' (Houston, TX: NACE International, 1981).
9. " 'News from the Field,' Tenneco Gas Deals with Chloride-Contaminated Pipe," Journal of Protective Coatings and Linings 6, 2 (1989): p. 34.
10. M.A. Kazemi, B.T. Nosé, "Fusion-Bonded Epoxy Pipe Coating: Preparation and Application Make a Big Difference," Journal of Protective Coatings and Linings 9, 5 (1992): pp. 52-56.
11. G.V. Spires, "Epoxy Linings for Stainless Steel and a Circulating Water System," Journal of Protective Coatings and Linings 5, 12 (1988): p. 38-45.
12. K.W. Ferry, "Cleaning Lined Tank Cars and Unlined Tank Cars for Lining Application," Materials Performance 30, 5 (1991): p. 37.
13. S. Frondistou-Yannas, "Effectiveness of Nonabrasive Cleaning Methods for Steel Surfaces," Materials Performance 25, 7 (1986): p. 53.
14. NACE Publication 6G186 (latest revision), "Surface Preparation of Contaminated Steel Surfaces" (Houston, TX: NACE International).

## Bibliography

Appleman, B.R. "Painting over Soluble Salts: A Perspective." Journal of Protective Coatings and Linings 4, 6 (1987): pp. 68-82.

Calabrese, C., J.R. Allen. "Surface Characterization of Atmospherically Corroded and Blast Cleaned Steel." Corrosion 34, 10 (1978): pp. 331-338.

Frenzel, L.M., J. Nixon. "Surface Preparation Using High-Pressure Water Blasting." CORROSION/89, paper no. 397. Houston, TX: NACE International, 1987.

[(5)]International Organization for Standardization (ISO) 1 rue de Varembe, Case Postale 56, CH 1121 Geneva 20, Switzerland.

Provided by : www.spic.ir Licensee: NISOC Library

**Table 1**
**Candidate Physical or Chemical Tests for Contaminants Remaining on "Cleaned Steel"**

| Class of Contaminant | Contaminant | Suggested Test | Existing Standard |
|---|---|---|---|
| Soluble in Water | Moisture | Cobalt chloride test paper | None |
| | Soluble Iron Salts | Potassium Ferricyanide test | BS 5493,Appendix G[B]<br>SABS Method 770[C]<br>DIN 55928 Part 4 [D] |
| | Soluble chlorides | Silver nitrate test paper<br>Aquaquant test kit<br>Ion Selective electrodes | SABS Method 770<br>None<br>None |
| | Soluble sulfates | Barium chloride/potassium permanganate test paper | SABS Method 770 |
| Soluble in Organic Solvents | Grease, oil and waxy residues | Fettrot test<br>Fluorescence test<br>Water break test<br>Solvent spotting test | DIN 55928 Part 4<br>DIN 55928 Part 4<br>None<br>None |
| Insoluble or of Low Solubility | Millscale | Copper sulfate test<br>Etch with 15% $HNO_3$<br>Differential resistance probe | SABS Method 771[#]<br>None<br>None |
| | Millscale, rust and dust | the "surclean" test | BS5493 Appendix F |
| | Loose rust and dust | Reflectometer<br>Tape Method | SABS Method 768[F]<br>SABS Method 771 |
| | Weld fluxes | pH test paper | none |

[A] Source: A.N. McKelvie, “Can Coatings Successfully Protect Steel, What Are the Ingredients of Success?” Materials Performance 19, 5 (1980): p. 13.
[B] BS5493 (latest revision), “Code of Practice for Protective Coating of Iron and Steel Structures Against Corrosion,” (Milton Keynes, United Kingdom: British Standards Institution).(6)
[C] SABS Method 770 (latest revision), (Pretoria, South Africa: South African Bureau of Standards).(7)
[D] DIN 55928, Parts 1-8 (latest revision), “Protection of Steel Constructions from Corrosion by Organic and Metal Coatings” (Berlin, Germany: Deutsches Institut fur Normung).(8)
[E] SABS Method 771 (latest revision), (Pretoria, South Africa: South African Bureau of Standards).
[F] SABS Method 768 (latest revision), (Pretoria, South Africa: South African Bureau of Standards).

[6] British Standards Institution (BSI), Linford Wood, Milton Keynes, Milton Keynes MK146LE, United Kingdom.
[7] South African Bureau of Standards (SABS), 1 Dr. Lategan Rd., Private Bag X191 Groenkloof, Pretoria, South Africa 00001, Republic of South Africa.
[8] Deutsches Institut fur Normung (DIN), Burggrafenstrasse 4-10, 1000 Berlin 30, Germany.

Provided by : www.spic.ir Licensee: NISOC Library

Johnson, W.C. "New Concepts for Coating Protection of Steel Structures." ASTM Special Publication 841. Philadelphia, PA: American Society for Testing and Materials, 1984.

McKelvie, A.N. "Can Coatings Successfully Protect Steel, What Are the Ingredients of Success?" Materials Performance 19, 5 (1980): p. 13.

McKelvie, A.N. "Steel Cleaning Standards-A Case for their Reappraisal." Journal of the Oil and Colour Chemists' Association 60 (1977): pp. 227-237.

Munger, C.G. "Sulfides-Their Affect on Coatings and Substrates." CORROSION/77, paper no. 1 (Houston, TX: NACE International, 1977).

Munger, C.G. "The Coating of Contaminated Ferrous Surfaces." NACE International Coatings Symposia Regional Meeting, Niagara, New York (Houston, TX: NACE International, 1979).

NACE Publication 6G186 (latest revision). "Surface Preparation of Contaminated Steel Surfaces." Houston, TX: NACE International.

NACE Standard TM0170 (latest revision). "Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive." Houston, TX: NACE International.

Rex, J. "A Review of Recent Developments in Surface Preparation Methods." Journal of Protective Coatings and Linings 7, 10 (1990): pp. 50-58.

Systems and Specifications: Steel Structures Painting Manual, Sixth Edition. Pittsburgh, PA: SSPC, 1991.

Trimber, K.A. "An Investigation into the Removal of Soluble Salts Using Power Tools and Steam Cleaning." SSPC: The Society for Protective Coatings Seventh Annual Symposium, paper SY-3.1. Pittsburgh, PA: SSPC, 1988.

Trimber, K.A. "Detection and Removal of Chemical Contaminants in Pulp and Paper Mills." Journal of Protective Coatings and Linings 5, 11 (1988): pp. 30-37.

Weldon, D.G., A. Bochan, M. Schleiden. "The Effect of Oil, Grease, and Salts on Coating Performance." Journal of Protective Coatings and Linings 4, 6 (1987): pp. 46-58.

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC-TR 2/NACE 6G198

# JOINT TECHNICAL REPORT

## Wet Abrasive Blast Cleaning

SSPC: The Society for Protective Coatings (SSPC) and NACE International (NACE) issue this report in conformance with the best current technology regarding the specific subject. This report represents a consensus of those individual members who have reviewed this document. It is intended to aid the supplier, the user and the general public. Its acceptance does not in any respect preclude any person or organization, whether they have adopted the report or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not in conformance with this report. Nothing contained in this report is to be construed as granting any right, by implication or otherwise, to manufacture, sell, or use in connection with any method, apparatus, or product covered by Letters Patent, or as indemnifying or protecting anyone against liability for infringement of Letters Patent. This report represents minimum requirements and should in no way be interpreted as a restriction on the use of better procedures or materials. Neither is this report intended to apply in all related cases. Unpredictable circumstances may negate the usefulness of this report in specific instances. SSPC and NACE assume no responsibility for the interpretation or use of this report by other parties and accept responsibility for only those official interpretations issued by SSPC or NACE in accordance with their respective governing procedures and policies, which preclude the issuance of interpretations by individual volunteers.

Users of this report are responsible for reviewing appropriate health, safety, and regulatory documents and for determining their applicability in relation to this report prior to its use. This SSPC/NACE report may not necessarily address all safety problems and hazards associated with the use of materials, operations, and/or equipment detailed or referred to within this document.

CAUTIONARY NOTICE: SSPC/NACE reports are subject to periodic review and may be revised or withdrawn at any time without prior notice. SSPC and NACE require that action be taken to reaffirm, revise, or withdraw this report no later than five years from the date of initial publication. The user is cautioned to obtain the latest edition. For information on this and other joint SSPC/NACE publications, contact either organization. The SSPC Publications Dept. may be reached at 40 24th Street, Pittsburgh, PA 15222-4656 (telephone +1 412-281-2331). The NACE International Membership Services Dept. may be reached at P.O. Box 218340, Houston, Texas 77218-8340 (telephone +1 281-228-6200).

## Foreword

This joint report was prepared by the SSPC/NACE Joint Task Group C on Wet Abrasive Blast Cleaning, which is comprised of members of both the SSPC Surface Preparation Committee and the NACE Unit Committee T6G on Surface Preparation. It is intended to be used primarily by specifiers, owners, painting contractors, inspectors, and others involved in surface preparation of industrial structures.

## 1. Scope

This document covers procedures, equipment, and materials involved in a variety of air/water/abrasive, water/abrasive, and water-pressurized abrasive blast cleaning systems. Equipment usage and safety are also discussed.

## 2. Description and Use

**2.1** Air/water/abrasive blasting is a cleaning method in which water is injected into the air/abrasive stream generated by conventional air-pressurized abrasive blasting equipment.

**2.1.1** Water helps to remove contaminants from the substrate, to wet the abrasive, and to substantially reduce dispersion of fine particulates (dust). Particulates are often caused by the breakup of the abrasives, surface corrosion products, and paint if the surface has been previously painted. Dust suppression is achieved by thoroughly wetting the abrasive and other particles to encapsulate them with a thin film of moisture. The objective is to remove contaminants and suppress the dusting effect caused by the impact of the abrasive on the substrate, while retaining the blasting characteristics of dry abrasive, including creation of anchor profile.

**2.1.2** Air/water/abrasive blasting is an alternative to water jetting, dry blasting, and water blasting with abrasive injection.

**2.1.3** Air/water/abrasive blasting is referred to hereafter as “wet blasting.”

**2.2** Water/abrasive blasting is a cleaning method in which abrasive is injected into the water stream generated by conventional fluid pumps.

Provided by : www.spic.ir Licensee: NISOC Library

**2.2.1** Water is the primary agent to remove the contaminants from the substrate. The abrasive is injected to help remove brittle contaminants and create a profile where necessary. Compared to wet blasting methods, water/abrasive blasting has a higher water to abrasive ratio. Dust suppression is achieved by the wetting of the abrasive and other particles. The objective is to remove contaminants with water and impact the abrasive on the substrate to retain the blasting characteristic of dry abrasive, including creation of anchor profile.

**2.2.2** Water/abrasive blasting is an alternative to dry blasting, wet blasting, or water jetting.[1]

## 3. Procedures and Parameters

**3.1** Wet blasting is generally considered suitable for use on any substrate for which the use of abrasive is appropriate. Wet blasting can often be adjusted to clean delicate substrates.

**3.2** Some wet blasting systems can utilize the same wide variety of available abrasives as conventional dry abrasive blast systems. Wet abrasive is more difficult to recycle than dry abrasive. In some cases, recycling of wet abrasive may not be possible. In some cases, the water may be recycled.

**3.3** The water flow rate and the ratio of water to abrasive are usually adjustable so that a wide range of applications, from washing of surface contaminants to white metal blast, can be accomplished.

**3.4** After wet blasting, all traces of abrasive and other loose particles are brushed, blown off with clean dry air, vacuumed, washed, or otherwise removed from the surface. Cleanliness of the surface cannot be overemphasized.

**3.5** The injection of water to the air/abrasive stream helps to remove contaminants such as dirt and water-soluble salts, including ferrous, chloride, or sulfate salts.[2]

**3.6** Inhibitors can be used to control flash rusting during wet or water/abrasive blasting. Many coating manufacturers prefer that inhibitors not be used in wet or water/abrasive blasting. (See Section 6.)

**3.7** Production rates vary due to variations in surfaces being blasted, the type of abrasive used, and the level of fine particulate dust suppression desired. Systems introduced since 1985 claim production rates equal to or higher than conventional dry blasting, but independent studies have not been published as of this publication date.

**3.8** Wet blasting is a process that can produce surface cleanliness and anchor profiles (surface roughness) similar to those obtained with dry blasting. The level of surface preparation specified is the same as that specified if dry blasting was the process being used. However, because the visual appearance of wet blasted surfaces is not necessarily the same as the visual appearance of dry blasted surfaces, care and judgment should be exercised by inspectors. It is common to encounter difficulty when visual inspection standards or aids prepared for dry blasting are used as inspection or judgment criteria for wet blasted surfaces. This visual difficulty can be lessened by preparation of a test patch which is agreed upon by the concerned parties during a pre-job conference.

## 4. Wet Blasting Equipment

**4.1** The equipment used for wet blasting generally consists of conventional dry abrasive blasting equipment supplemented with modules to inject water into the abrasive stream. Ideally, the water encapsulates the abrasive particles with a thin film of moisture to suppress and contain the dust generated by the impact of the abrasive with the substrate. Abrasive injection into water blast equipment will also be discussed.

Systems are available that allow the operator to select adjustable rates of air, water, or abrasive as necessary to achieve optimum results. Some systems allow independent adjustment of each of these parameters while the system is in operation. Some systems also allow independent adjustment for each nozzle for multi-nozzle setups.

### 4.2 TYPES OF WET BLASTING SYSTEMS

**4.2.1 General Requirements of Wet Blast Units:** Most systems under the general classification of wet blast units contain a conventional dry abrasive blast pot with OSHA/NIOSH required deadman and other safety features, plus the normal complements of abrasive metering valve(s), compressed air inlet valve(s), blast hose, dry abrasive blast nozzle, etc. With these systems, the compressed air volumes and pressures are the same as for conventional dry abrasive blasting. Each of these systems can clean to SSPC-SP 5/NACE No. 1 (White Metal) and create a suitable anchor pattern for paint adhesion.

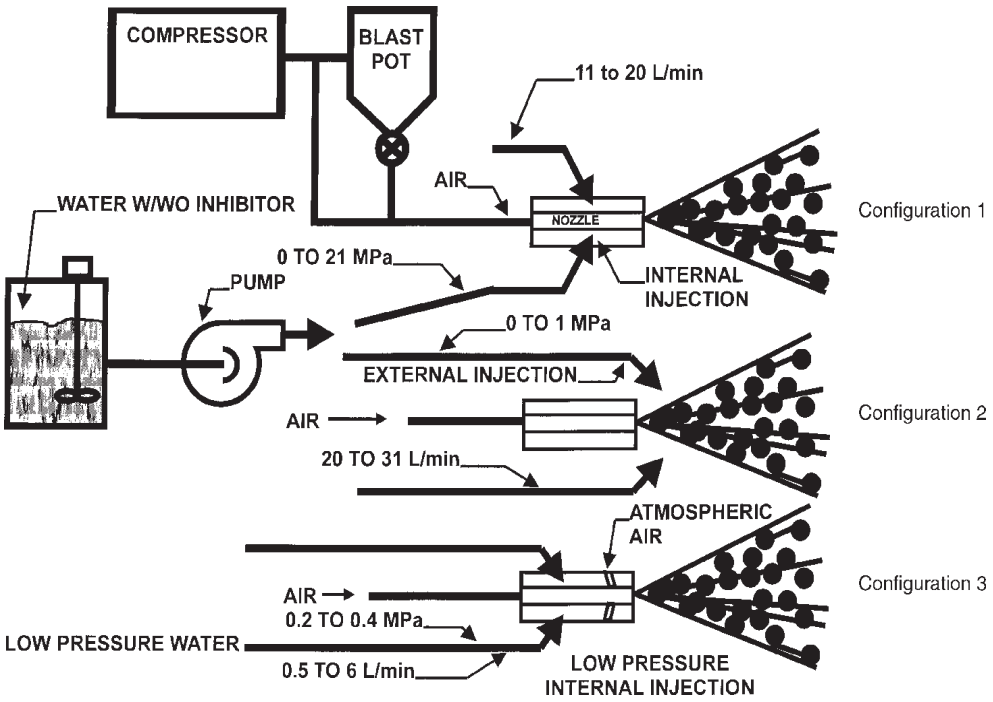
---

[1]Water jetting is defined in NACE No.5/SSPC-SP 12 as "the use of standard jetting water at high or ultrahigh pressure to prepare a surface for recoating using pressures above 70 mPa." Standard jetting water does not contain sediments or abrasive media.

[2]See NACE Publication 6G1-86 (latest revision), "Surface Preparation of Contaminated Steel Surfaces," and other items in the Bibliography.

Provided by : www.spic.ir Licensee: NISOC Library

**FIGURE 1**




**4.2.2 Radial Water Injectors**: Some of these are commonly referred to as "water rings,"and are available in three basic configurations. In the first configuration, water is injected at an angle toward the center of the blast stream as the air/abrasive stream enters the blast nozzle. The water is normally injected at or just above the pressure of the compressed air. (See Figure 1.) The second configuration is a "donut" that fits over the outside of the dry blast nozzle. Water is injected from around the outside of the blast stream radially inward at an angle toward the center of the blast stream as the air/abrasive stream exits the nozzle. The third configuration utilizes a wet blast venturi nozzle which allows water and atmospheric air to be inducted at midpoint in the nozzle behind the bore restriction.

**4.2.3 Coaxial Water Injectors:** In these systems the water is injected directly into the throat of the blast nozzle. The direction of water injection is parallel to the flow of the air/abrasive stream. The air/abrasive stream and the water stream have the same axis or center line. (See Figure 2.)

**4.2.4 Slurry Blasters:** The term "slurry blasting" is commonly used for the systems described in Sections 4.2.4 and 4.2.5. In these devices, the water is injected into the air/abrasive stream at some point substantially upstream from the blast nozzle. This allows the air/abrasive/water mixture to tumble for some distance in the blast hose to mix with and wet the abrasive. Typically, the water is injected at the blast pot abrasive metering valve or at a blast hose connection. Sometimes the water is injected at the connection point of the whip hose to the main blast hose. (See Figure 3, Configuration 1.)

In Figure 3, Configuration 2, the abrasive is loaded into a pressure vessel and simultaneously mixed with water. The vessel, loaded with the abrasive/water combination, is then pressurized using an integrated pump and the mixture is injected into the air stream. The unencumbered air flow reduces overall water consumption rates and provides good dust suppression. Wet abrasive can be reused in the configuration 2 system as long as the abrasive has not been crushed during the cleaning process and the material being removed in the blasting process is non-hazardous.

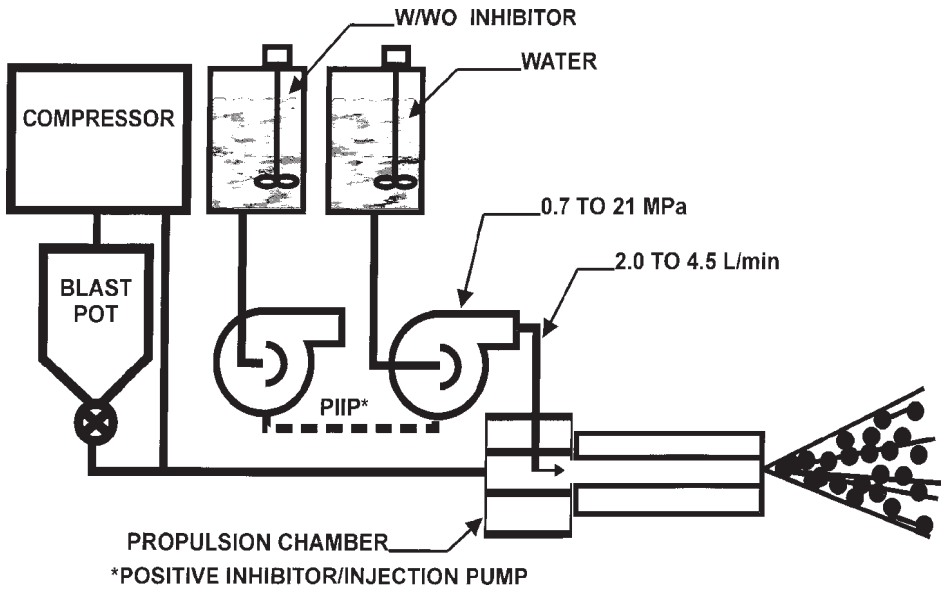
**4.2.5 Water Blast with Abrasive Injection:** These devices differ from the units described in Sections 4.2.2 through 4.2.4 in that the propelling force is the water stream, not compressed air. This method is commonly referred to as "abrasive wet jet" or "AWJ", or "slurry blasting." The typical devices consist of a fluid pump with a venturi nozzle of some type in which the water flow draws the abrasive into the water stream or the abrasive media is injected into the water stream under pressure. Because the fluid stream is well defined, these devices usually cut a narrow blast pattern. (See Figure 4.)

### 4.3 WATER DELIVERY SYSTEM

**4.3.1 Purity of Water:** The purity of the water used for wet abrasive blasting (or any wet cleaning method) can affect the quality of the cleaned substrate. To achieve a clean substrate, demineralized, potable, or other water that will not impose additional contaminants on the surface being cleaned is acceptable. There is no current definitive number

Provided by : www.spic.ir Licensee: NISOC Library

FIGURE 2



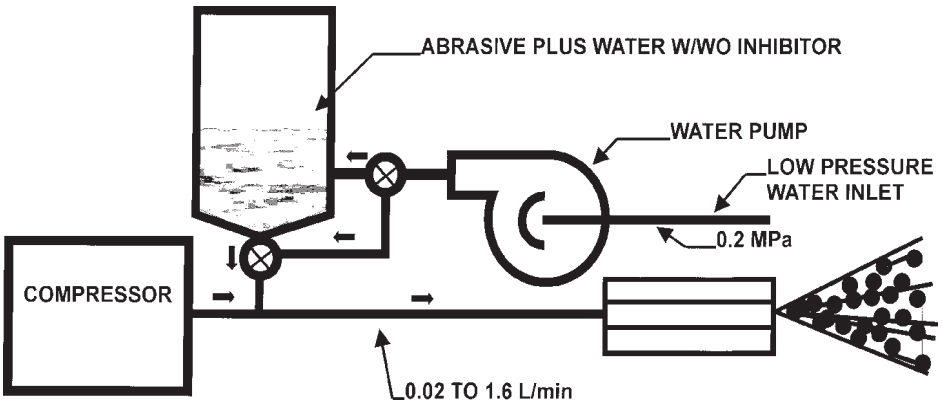




FIGURE 3, Configuration 1

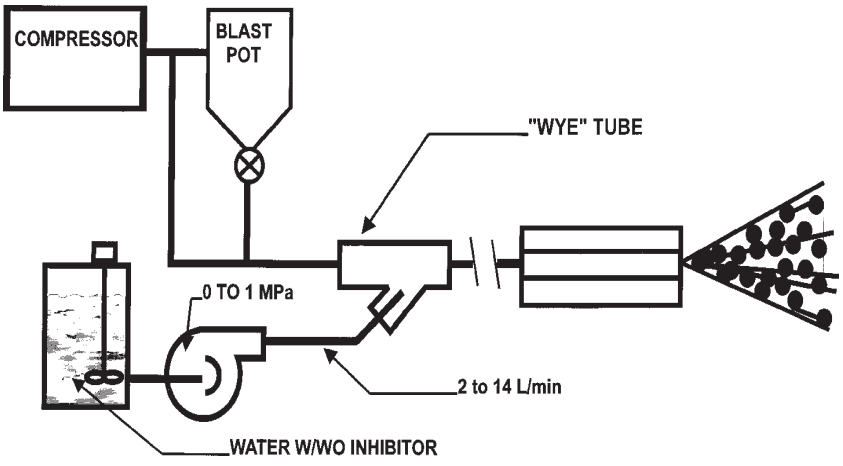



FIGURE 3, Configuration 2

Provided by : www.spic.ir Licensee: NISOC Library

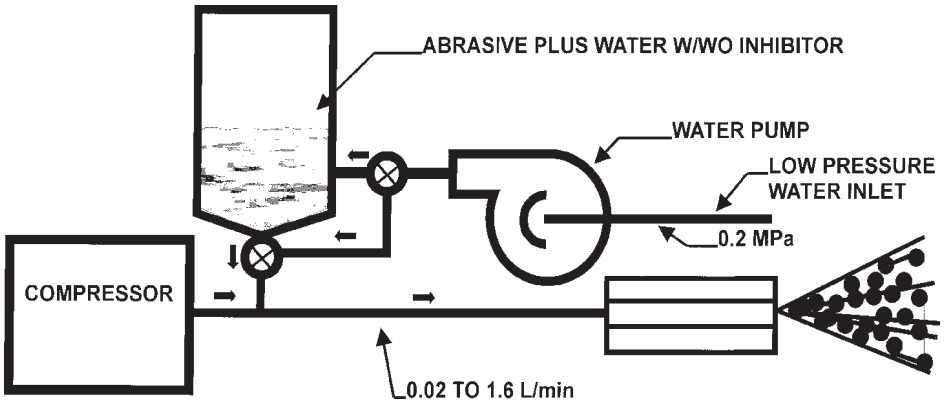
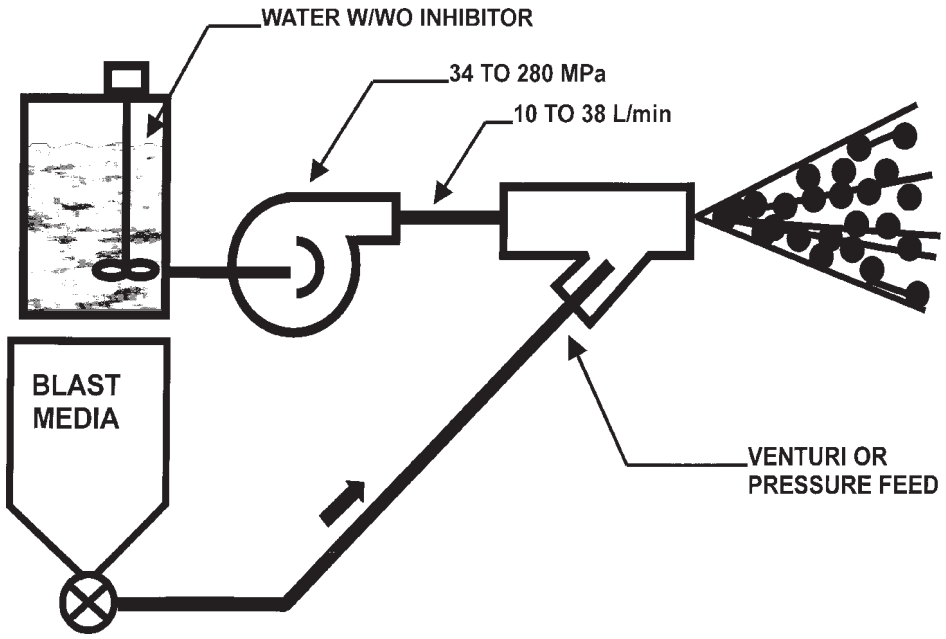



**FIGURE 3, Configuration 3**

**FIGURE 4**




for acceptable levels of water purity. The quality contamination of the substrate may be tested and confirmed. Recycled water may contain a buildup of contaminants.

**4.3.2 Water Flow Rates Requirements:** The system has sufficient water inlets with filters at the suction side of the pump to provide an adequate supply of water to the pump . The pump is capable of providing the water pressure at the required flow rates of the type of wet blast injector being used. Typical water flow rates and water pressures are:

a. Radial Water Injectors: 0.5 to 31 L/min (0.2 to 8 gpm) at 0.2 to 21 MPa (25 to 3,000 psi)
b. Coaxial Water Injectors: 2 to 4 L/min (0.5 to 1 gpm) at 0.7 to 21 MPa (100 to 3,000 psi)
c. Slurry Blasters (Figure 3, Configuration 1): 2 to 4 L/min (0.5 to 3 gpm) at 0.7 MPa (150 psi); Figure 3, Configuration 2, 0.02 to 1.6 L/min (0.0005 to 0.4 gpm) at 0.2 MPa (25 psi)
d. Water Blast with Abrasive Injection: 10 to 38 L/min (2.5 to 10 gpm) at 34 to 280 MPa (5,000 to 40,000 psi)

Provided by : www.spic.ir Licensee: NISOC Library

**4.3.3 Inhibitors:** Where inhibitors are used, typical inhibitor/water ratios range from 1:1 to 1:1000. The inhibitor injector can be positively interlocked to the water pump to provide a uniform metered supply and constant concentration of inhibitor in the blasting water or mixed in a reservoir water supply. Other techniques, such as addition of inhibitor to a reservoir, can be equally efficient. The inhibitor or wet blast equipment supplier or manufacturer sometimes sets forth special recommendations. (See Section 6.)

## 5. Selection of Abrasives

**5.1 GENERAL:** Virtually any type of abrasive commonly used with conventional dry blasting can be utilized with the radial and coaxial injection type wet blasting devices (Sections 4.2.2 and 4.2.3), because they are supplemental to conventional blast equipment and the abrasive is not wetted in the blast hoses. (See SSPC-AB 1, "Mineral and Slag Abrasives.")

**5.2** The following are some considerations when selecting an abrasive:

**5.2.1 Salt Content:** The salt content of abrasives can contaminate a blast cleaned surface.

**5.2.2 Hardness and Sharpness:** The harder and sharper the abrasive particles, the higher the productivity of the operators.

**5.2.3 Particle Size:** Utilizing a larger particle size decreases the tendency to create mud in corners and tight spots.

**5.2.4 Mud Caking in Slurry Blasters:** Development of "mud caking" in the blast hose in Figure 3 Configuration 1 (Section 4.2.4) causes frequent clogging of slurry blasters with many types of abrasives. Therefore, only abrasives which contain low levels of water soluble materials and which are not easily crushed are used with this type of slurry blasting equipment.

## 6. Inhibitors

**6.1 PREVENTING FLASH RUSTING:** Surfaces cleaned by water tend to flash rust. The rate of flash rusting depends upon how long the surface stays wet, ambient conditions such as temperature and relative humidity, purity of the water, contaminants remaining on the surface, and contaminants in the abrasive. Inhibitors retard the rate of flash rusting. CAUTION: Inhibitors may mask contaminants on the surface or introduce residues that interfere with coating performance.

**6.2 REGULATIONS:** Inhibitors complying with relevant federal, state, and local regulations are used.

**6.3 COMPATIBILITY WITH COATING:** Consult the coating supplier to make sure the inhibitors used do not interfere with the cure or the coating performance. Consult ASTM D 5367, "Standard Practice for Evaluating Coatings Applied over Surfaces Treated with Inhibitors Used to Prevent Flash Rusting of Steel When Water or Water/Abrasive Blasted" for information on compatibility of inhibitors with coatings.

**6.4 USAGE:** Inhibitors can be used in either the blast water or rinse water. The inhibitor manufacturer is consulted for specific usage recommendations.

## 7. Operation of Equipment

**7.1 GENERAL:** The equipment start-up sequence, operation, and preventative maintenance are followed in accordance with the manufacturer's instructions and the procedures listed in Section 7.2. The safety guidelines listed in Section 8 of this document and the safety requirements of 29 CFR 1910.94 and 1910.1000 are also observed.

**7.2 EQUIPMENT START-UP SEQUENCE, OPERATION, AND MAINTENANCE:**

**7.2.1** All equipment (including gauges and controls) is checked to verify that it is clean and is operating properly before work is started. The system is tested to the maximum working pressure to ensure integrity of the connections.

**7.2.2** The air, water, and abrasive blast hoses are checked to ensure that they are not frayed, kinked, or worn. This is essential for operator safety, because a blow-out could be very hazardous.

**7.2.3** The water supply is filtered or otherwise treated to remove contaminants that could damage pumps and valves or leave corrosive deposits on the surface being cleaned.

**7.2.4** As in conventional dry abrasive blasting, the hose size is as large as practical for the operator to handle, and as short as feasible to reduce the pressure drop from the pressure source to the nozzle.

**7.2.5** Clean and dry abrasive is used.

**7.2.6** Water pressure and flow rate are set to maximize production while suppressing the excessive generation of fine particulates. Increasing the water flow rate above the optimum often has a negative effect on productivity by cushioning the impact of the abrasive particles, rather than increasing cleaning rates significantly. (See Section 4.3.2 for water flow rates.)

Provided by : www.spic.ir Licensee: NISOC Library

**7.2.7** The nozzle distance to the work piece and the angle of incidence are adjusted to optimize cleaning rates. Heavier rust and tightly adherent materials are often more effectively removed by holding the nozzle closer to the work piece. An 80°-90° angle of attack has also been found to enhance the removal of this type of material.

**7.2.8** Some specialized procedures for using the wet blast equipment consist of utilizing a relatively short sand-blast whip line (with a diameter slightly larger than normal) and a blast nozzle that is one size larger than is used with conventional dry blasting. The water injector is kept as close to the blast nozzle as possible to minimize mud caking in the blast hose.

## 8. Safety Guidelines

**8.1** The fine particulates and mist from the impact of the abrasive upon the substrate contain dust particles similar to those found in dry abrasive blasting. The concentration of particulates is, however, lower in wet blasting. Nonetheless, take precautions to avoid inhalation of particulates from blasting that may remain in the air for a considerable amount of time.

**8.2** The wet blast procedures follow all the safety guidelines for conventional dry abrasive blast equipment. (See 29 CRF 1910.93 and 29 CFR 1910.1000.)

**8.3** Only trained operators should be permitted to utilize the equipment. They are equipped with suitable protection such as blast gloves, air-fed blast hoods, rain suits, foot protection, and hearing protection.

**8.4** The nozzle should be pointed at the work surface only—never at personnel or other objects.

**8.5** Water conducts electricity. Exercise caution around electrical equipment, wiring, or conduit. A safety professional should be consulted before beginning blast procedures.

**8.6** All operation controls should be checked prior to work initiation.

**8.7** Operators should wear required personal safety gear. They should establish a stable footing base and anticipate blast nozzle thrust and possible obscuring of vision prior to starting the blast.

**8.8** Water runoff and blast debris should be handled in compliance with applicable safety and environmental regulations.

## Bibliography

ASTM Standard D 5367, “Standard Practice for Evaluating Coatings Applied over Surfaces Treated with Inhibitors Used to Prevent Flash Rusting of Steel When Water or Water/Abrasive Blasted” (latest revision). West Conshocken, PA: ASTM.

Bleile, H. R., Rodgers, S. D., Porter, F., Smith, A. E., and Griffin, J. “Specification for Abrasive Blasting Media,” Surface Preparation: The State of the Art, Proceedings of the SSPC Annual Symposium, May 1985, SSPC 85-06. Pittsburgh, PA: SSPC, 1985.

Chandler, K. A. “The Influence of Salts in Rusts on the Corrosion of the Underlying Steel.” British Corrosion Journal, Vol. 1, July 1966: pp. 264-266.

Code of Federal Regulations (CFR) 1910.94, “Ventilation” (latest revision). Washington, DC: Office of the Federal Register.

Code of Federal Regulations (CFR) 1910.1000, “Air Contaminants.” (latest revision). Washington, DC: Office of the Federal Register.

Dasgupta, D., and Ross, T. K. “Cleaning of Rusty Steel for Painting,” British Corrosion Journal, Vol. 6, November 1971: pp. 237-240.

Joint Surface Preparation Standard SSPC-SP 5/NACE No. 1, “White Metal Blast Cleaning” (latest revision). Pittsburgh: SSPC and Houston: NACE International.

NACE Publication 6G1-86 (latest revision), “Surface Preparation of Contaminated Steel Surfaces.” Houston, TX: NACE International.

Soltz, G. C. “The Effect of Substrate Contaminants on the Life of Epoxy Coatings Submerged in Sea Water.” National Shipbuilding Research Program Report, March 1991.

SSPC Standard SSPC-AB 1, “Mineral and Slag Abrasives” (latest revision). Pittsburgh, PA: SSPC.

Weldon, D. G. and Cain, T. A. “Salts: Their Detection and Their Influence on Coating Performance,” Surface Preparation: The State of the Art, Proceedings of the SSPC Annual Symposium, May 1985. (SSPC 85-06). Pittsburgh, PA: SSPC, 1985.

Woodson, J. P., “Fundamentals of Wet Abrasive Blasting.” Materials Performance 27, 10 (1988).

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# ABRASIVE SPECIFICATION NO. 1

## Mineral and Slag Abrasives

### 1. Scope

**1.1** This specification defines the requirements for selecting and evaluating mineral and slag abrasives used for blast cleaning steel and other surfaces for painting and other purposes.

**1.2** The abrasives covered by this specification are primarily intended for one-time use without recycling; reclaimed materials must again be tested against and meet the requirements of this specification. (See Note 7.1.)

### 2. Description

**2.1** The abrasives are categorized into two types, three classes and five grades as described below. Normally the user shall specify the types, classes and grades required. If no abrasive type is specified, then either Type I or Type II is considered acceptable. If no abrasive class is specified, then any class will be considered acceptable. If no abrasive profile grade is specified, the abrasive shall satisfy the requirements of any of the five grades listed.

**2.2** The following abrasive types are included.

**Type I** - Natural Mineral Abrasives

These are naturally occurring minerals, including, but not limited to, quartz sands, flint, garnet, staurolite, and olivine.

**Type II -** Slag Abrasives

These are slag by-products of coal-fired power production or of metal (such as copper or nickel) smelting.

**2.3** The following abrasive classes are included.

**Class A** - Crystalline silica less than or equal to 1.0%
**Class B** - Crystalline silica less than or equal to 5.0%
**Class C** - Unrestricted crystalline silica

The definition and requirements for Classes A, B and C are given in Section 4.2.

**2.4** The abrasive grades and associated profile ranges are listed below:

- **Grade 1** - Abrasives which produce surface profiles of 0.5 to 1.5 mils (13 to 38 micrometers) when tested in accordance with Section 4.3.
- **Grade 2** - Abrasives which produce surface profiles of 1.0 to 2.5 mils (25 to 64 micrometers) when tested in accordance with Section 4.3.
- **Grade 3** - Abrasives which produce surface profiles of 2.0 to 3.5 mils (51 to 89 micrometers) when tested in accordance with Section 4.3.
- **Grade 4** - Abrasives which produce surface profiles of 3.0 to 5.0 mils (75 to 127 micrometers) when tested in accordance with Section 4.3
- **Grade 5** - Abrasives which produce surface profiles of 4.0 to 6.0 mils (102 to 152 micrometers) when tested in accordance with Section 4.3.

Other profile ranges may be designated by the purchaser.

### 3. Reference Standards

**3.1** The reference standards listed in Sections 3.4 and 3.5 form a part of this specification.

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

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

**3.4 SSPC SPECIFICATIONS:**

| | |
|---|---|
| **VIS 1** | Visual Standard for Abrasive Blast Cleaned Steel |
| **SP 10** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **C 128** | Test Method for Specific Gravity and Absorption of Fine Aggregates |
| **C 136** | Test Method for Sieve Analysis of Fine and Coarse Aggregates |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **C 566** | Test Method for Total Moisture Content of Aggregate by Drying |
| **C 702** | Method for Reducing Field Samples of Aggregate to Testing Size |
| **D 75** | Method for Sampling Aggregates |
| **D 1125** | Test Methods for Electrical Conductivity and Resistivity of Water |
| **D 4417** | Test Method for Field Measurement of Surface Profile of Blast Cleaned Steel |
| **D 4940** | Test Method for Conductimetric Analysis of Water Soluble Ionic Contaminants of Blasting Abrasives |
| **E 1132** | Practice for Health Requirements Relating to Occupational Exposure to Quartz Dust |

## 4. Requirements

**4.1 GENERAL PHYSICAL AND CHEMICAL PROPERTIES:** The abrasive shall meet all the requirements of paragraphs 4.1.1 through 4.1.6. These are summarized in Table 1.

**4.1.1 Specific Gravity:** The specific gravity shall be a minimum of 2.5 as determined by ASTM C 128.

**4.1.2 Hardness:** The hardness shall be a minimum of 6 on the Mohs scale when tested as follows: Examine the material under low-power microscope (10X) and if grains of different colors or character are present, select a few grains of each. Place in succession the grains thus differentiated between two glass microscope slides. While applying pressure, slowly move one slide over the other with a reciprocating motion for 10 seconds. Examine the glass surface, and if scratched, the material shall be considered as having a minimum hardness of 6 on the Mohs scale. If more than 25% of the grains by count fail to scratch the glass surface, the abrasive does not meet this specification.

**4.1.3 Weight Change on Ignition:** The maximum permissible loss on ignition is 1.0% and the maximum permissible gain is 5.0% when tested as follows: A representative portion of the sample shall be ground in an agate mortar and thoroughly dried at 220- 230°F (105-110°C) for one hour. Transfer approximately 1 gram of the dried sample to a tared crucible with cover and weigh to the nearest milligram. Cautiously heat the crucible with contents, at first partially covered, and then at approximately 1382 ± 90°F (750 ± 50°C) covered. Hold at 1382°F (750°C) for 30 minutes, then cool in a dessicator and reweigh. The percent of weight change shall be computed as follows:

$$\% \text{ weight change} = \frac{(\text{final wt.} - \text{orig. wt.}) \times 100}{\text{orig. wt.}}$$

**4.1.4 Water Soluble Contaminants:** The conductivity of the abrasive shall not exceed 1000 microsiemen when tested in accordance with ASTM D 4940. (See Note 7.3.)

**4.1.5 Moisture Content:** The maximum moisture content shall be 0.5% by weight, when tested in accordance with ASTM C 566.

**4.1.6 Oil Content:** The sample, in water, when tested in 4.1.4, shall show no presence of oil, either on the surface of the water or as an emulsion in the water, when examined visually after standing for 30 minutes.

**4.2 CRYSTALLINE SILICA CONTENT**: All abrasives must be classed based on crystalline silica content (see Note 7.4). Abrasives designated as Class A or B must meet the requirements of paragraphs 4.2.1 or 4.2.2 respectively.

**4.2.1 Class A - Less Than 1% Crystalline Silica:** Abrasives shall contain no more than 1.0% by weight of crystalline silica when determined in accordance with procedures described in 4.2.4.

**4.2.2 Class B - Less than 5% Crystalline Silica:** Abrasives shall contain no more than 5.0% by weight of crystalline silica when determined in accordance with procedures described in 4.2.4.

**4.2.3 Class C - Unrestricted Crystalline Silica:** No restrictions on crystalline silica content.

**4.2.4 Crystalline Silica:** The crystalline silica content shall be determined by the use of infrared spectroscopy or by other analytical procedures, such as wet chemical or X-ray diffraction analyses.

**4.3 SURFACE PROFILE**: The average surface profile, when determined in accordance with the description below, shall be within the ranges specified in Section 2.4. A representative sample of the material shall be obtained in accordance with ASTM D 75 and used to abrasive blast a 2-foot by 2-foot by 1/4 inch (61 cm x 61 cm x 4 mm) mild steel plate of SSPC-VIS 1 Rust Grade A to a cleanliness of SSPC-SP 10 (Near-White Blast Cleaning). The blasting shall be done using a 3/8 in (9.5 mm) #6 venturi nozzle with a nozzle pressure of 95 ± 5 psig (670 ± 35 kilopascals) at a distance of 24 ± 6 inches (61 ± 15 cm) from the surface at an angle of 75 to 105 degrees. The resultant surface profile shall be measured at a minimum of five locations in accor-

Provided by : www.spic.ir Licensee: NISOC Library

dance with Method C of ASTM D 4417 (see Note 7.5). The average measured profile shall be within the ranges given in Section 2.4. Other methods of determining profile may be used if mutually agreeable between the contracting parties.

**4.4 PARTICLE SIZE DISTRIBUTION**

**4.4.1** The abrasive supplier shall designate range(s) for maximum and minimum retention of each sieve size to meet the profile range(s) specified in Section 2.4 and determined in Section 4.3. The particle size distribution shall be measured in accordance with ASTM C 136 using the following U.S. standard sieves: 6, 8, 12, 16, 20, 30, 40, 50, 70, 100, 140, and 200. Upon request, the supplier shall substantiate that the specified size range will meet the required profile range. (See Note 7.6.)

**4.4.2** The designated sieve size distribution and ranges will become the acceptance standard for the specific abrasive submitted (see Section 5.4).

**4.5 HEALTH AND SAFETY REQUIREMENTS**

**4.5.1** The abrasive material as supplied shall comply with all applicable federal, state, and local regulations (see Note 7.7).

**4.5.2** The manufacturer shall provide the purchaser with sufficiently detailed chemical analyses to allow the user to provide the protective engineering and administrative controls for blast cleaning identified in federal, state, and local codes.

**4.5.3** Material Safety Data Sheets shall be furnished for all abrasive materials supplied.

**4.6 OTHER REQUIREMENTS**

**4.6.1** In addition to the requirements of Sections 4.1 through 4.5, the specifier may also stipulate performance tests to establish abrasive consumption rate, cleaning rate, and abrasive breakdown. As there are currently no standards for these tests, they are not a part of this specification. However, upon mutual agreement between supplier and purchaser, a performance test procedure can be established. Appendix A outlines a suggested procedure.

## 5. Qualification Testing and Conformance Testing

**5.1 RESPONSIBILITIES FOR TESTING:** The procurement documents should establish the specific responsibilities for qualification testing and conformance testing. Unless otherwise specified, the supplier is responsible for performing and documenting the tests and inspections called for in this specification.

**5.2 CLASSIFICATION OF TESTING:** The tests given in Section 4 are classified as qualification tests or conformance tests, as defined below:

**5.2.1** Qualification tests are those tests which are run to initially qualify a material for this specification. Qualification tests are also required whenever a significant change has occurred in the source, method of processing, method of shipping or handling of the abrasives. The qualification tests include all the tests in Sections 4.1 through 4.6.

**5.2.2** Conformance tests are those tests which are performed to verify that the material being submitted has the same properties as the material which initially qualified. Conformance tests shall be conducted on each lot as required by the purchaser. The frequency and lot size for quality conformance testing shall be mutually agreed upon between the supplier and the purchaser. The required conformance tests are particle size distribution (Section 4.4), water soluble contaminants (Section 4.1.4), moisture content (Section 4.1.5) and oil content (Section 4.1.6).

**5.3 METHODS OF SAMPLING**

**5.3.1 Sampling for Qualification Tests**

**5.3.1.1 Bagged Abrasive:** Three or more sacks of abrasive shall be randomly selected from each inspection lot. The sacks shall be mixed and separated and a 50 kilogram (kg) (110 lb) composite sample prepared in accordance with ASTM C 702.

**5.3.1.2 Bulk Abrasive:** A 50 kg (110 lb) composite sample shall be obtained from the blended finished product in accordance with ASTM D 75. (See Note 7.8.)

**5.3.2 Sampling for Conformance Tests**

**5.3.2.1 Bagged Abrasive:** One sack of abrasive shall be randomly selected from each inspection lot and a 2 kg (4 lb) composite sample prepared in accordance with ASTM C 702.

**5.3.2 2 Bulk Abrasive.** A 2 kg (4 lb) composite sample shall be obtained from the blended finished product in accordance with ASTM D 75.

**5.3.3** Other methods of sampling may be used if mutually agreeable between the contracting parties.

**5.4 DOCUMENTATION OF INSPECTION AND TESTING:** The supplier shall furnish all documentation required

Provided by : www.spic.ir Licensee: NISOC Library

to verify that he has completed the requirements of the qualification tests and conformance tests specified. At a minimum, the documentation shall include the following:

**5.4.1 List of tests performed:** This list shall include the title of the test, the appropriate standards used, any deviation from standard practice, and the numerical results of the testing.

**5.4.2 Testing facilities:** The documentation of facilities shall include the name and location of the laboratory, the responsible laboratory official, and laboratory certification or other evidence of qualification.

**5.4.3 Date of testing:** This shall include the date of original qualification (if applicable) and dates of completion and official approval of testing results.

**5.4.4 Affidavit:** The procurement documents should establish the responsibility for any required affidavit certifying compliance with this specification.

**5.5 FREQUENCY OF TESTING AND INSPECTION:** All materials supplied under this specification shall be subject to timely inspection by the purchaser or his authorized representative. The frequency and lot size of inspection shall be established by mutual agreement between the supplier and the purchaser.

**5.6 APPROVAL:** The purchaser shall have the right to reject any material supplied which is found to be defective under this specification. In case of dispute, the arbitration or settlement procedure, if any, established in the procurement documents shall be followed. If no arbitration procedure is established, the procedures specified by the American Arbitration Association shall be used.

## 6. Disclaimer

**6.1** While every precaution is taken to insure that all information furnished in SSPC specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials or methods specified therein, or of the specification itself.

## 7. Notes*

**7.1** Reclaimed abrasive may not meet the requirements of this specification because of particle degradation and retained contaminants. To confirm compliance, reclaimed abrasive shall be retested.

**7.2** Materials furnished under this specification which produce the required surface profile under standard test conditions may produce a different surface profile depending upon job condition, type of surface, blasting pressure, etc.

**7.3** The limitation for abrasive conductivity is based on pressure immersion testing and accelerated outdoor exposure tests performed by SSPC and the National Shipbuilding Research Program.

**7.4** Users of abrasives containing quartz (crystalline silica) should comply with the requirements of ASTM E 1132.

**7.5** Methods A and B of ASTM D 4417 or National Association of Corrosion Engineers RP02-87, “Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Using Replica Tape” may also be specified by agreement between purchaser and supplier.

**7.6** SSPC will maintain a list of abrasives and sieve sizes for which data on profile and other specified tests have been submitted. The data will not be verified by SSPC, but will be furnished upon request to those wishing to use this specification. It is anticipated that at a future date, specific size designations for individual abrasives will be incorporated into this or another SSPC specification.

**7.7** Disposal of abrasives should be in compliance with all applicable federal, state, and local regulations. It is noted that the spent abrasive may contain hazardous paint and other foreign matter.

**7.8** The importance of properly obtaining a sample cannot be over-emphasized. All subsequent analyses performed on the selected sample are likely to be affected by particle size, so it is imperative that every reasonable effort be made to select the sample in a way that will assure proper representation. Therefore, it is important to select the proper sampling location, and to use proper techniques to select the sample.

The following guidelines should be kept in mind when deciding on a sampling method:

**7.8.1** If possible, sample the material to be tested when it is in motion, in such places as a conveyor output point or a chute discharge.

**7.8.2** The whole of the material stream should be taken for many short periods of time in preference to part of the material stream being taken for the whole of the time.

*Notes are not requirements of this specification.

Provided by : www.spic.ir Licensee: NISOC Library

## Appendix A. Optional Test To Determine Rates of Surface Cleaning by Abrasives and of Abrasive Consumption*

### A.1 TEST PROCEDURE

**A.1.1** For testing purposes hot rolled carbon steel plates or other flat structural steel with surface area of 20 to 80 sq. ft. (1.9 to 7.4 $m^2$) shall be abrasive blast cleaned to a SSPC-SP 10 "Near White" condition. Surface profile shall range from 2.0 to 3.0 mils (51 to 76 micrometers) when measured by replica tape (ASTM D-4417, Method C). These panels shall be coated within 4 hours of abrasive blasting, or before surface rusting is visible —whichever occurs first.

**A.1.2** The panels prepared in A.1.1 shall be coated with three coats of epoxy-polyamide paint (total DFT 7-10 mils [178-254 micrometers]) conforming to MIL-DTL-24441 or other standard reference painting system agreed to by the contracting parties. The panels shall be cured for a minimum of seven days at a minimum temperature of 70°F (21° C). Following curing. the panels shall be marked in such a manner as to form a grid of squares, each being 1 sq. ft. (0.09 $m^2$) in area. Each plate shall contain a minimum of 20 squares.

**A.1.3** Each abrasive type and size selected shall be tested using a 3/8 inch (9.6 mm) venturi nozzle operated at $95 \pm 5$ psig ($655 \pm 35$ kilopascals) at the nozzle. A 600 lb pot shall be charges with 500 lbs (227 kg) of abrasive and the test panel blasted to SSPC-SP 10 near-white condition. Each trial shall cover approximately 20 sq. ft. (2 $m^2$) of surface area. The blast pot shall be disconnected and weighed before and after each blast trial, and the following data recorded: start weight, finish weight, weight of abrasive used, square footage blasted, and time required to blast.

**A.2 ABRASIVE CONSUMPTION RATE:** The abrasive consumption rate shall be determined as the weight of abrasive used divided by the area cleaned, and reported in lbs of abrasive per square foot (kg per $m^2$).

**A.3 SURFACE CLEANING RATE:** The surface cleaning rate shall be determined as the area cleaned divided by the time required to blast and reported in square feet (square meters) cleaned per hour.

*The Appendix is not a requirement of this specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-AB 2
May 1, 1996
Editorial Changes September 1, 2000

# SSPC: The Society for Protective Coatings

# ABRASIVE SPECIFICATION NO. 2

## Cleanliness of Recycled Ferrous Metallic Abrasives

## 1. Scope

**1.1** This specification covers the requirements for cleanliness of recycled ferrous metallic blast cleaning abrasives used for the removal of coatings, paints, scale, rust and other foreign matter from steel or other surfaces.

**1.2** Requirements are given for lab and field testing of recycled ferrous metallic abrasives work mix.

**1.3** Recycled ferrous metallic abrasives are intended for use in field or shop abrasive blast cleaning of steel or other surfaces.

## 2. Description

**2.1 FERROUS METALLIC ABRASIVES:** Ferrous metallic abrasives are used for blast cleaning steel and other surfaces. The inherent value of ferrous metallic abrasives is their ability to be recycled many times. The recycled abrasive must be cleaned to remove abrasive fines and debris, including paint, rust, mill scale, and other contaminants generated during the blast cleaning of steel or other surfaces.

**2.2 RECYCLED ABRASIVE WORK MIX:** The work mix develops during blast cleaning and recycling and is composed of new abrasive additions and recycled abrasive. The new abrasive being added may consist of shot, grit, or a mix of shot and grit.

## 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Section 3.4 and form a part of this specification.

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

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

**3.4 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 3335** | Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy |
| **D 4940** | Test Method for Conductimetric Analysis of Water Soluble Ionic Contaminants of Blasting Abrasives |
| **E 11** | Specification for Wire Cloth Sieves for Testing Purposes |

## 4. Requirements for Recycled Work Mix Abrasives

**4.1 NON-ABRASIVE RESIDUE:** Using the procedure defined in Section 5.1, the non-abrasive residue shall not exceed 1% by weight of the work mix sample taken for testing.

**4.2 LEAD CONTENT:** The maximum lead content of the work mix shall be 0.1% by weight (1000 ppm) when tested in accordance with Section 5.2.

**4.3 WATER-SOLUBLE CONTAMINANTS:** The conductivity of the abrasive shall not exceed 1000 micromhos/cm. (See Note 9.1.)

**4.4 OIL CONTENT:** The abrasive sample in water shall show no presence of oil, either on the surface of the water or as an emulsion in the water when examined visually after standing for 10 minutes.

**4.5 FAILURE TO MEET REQUIREMENTS:** Should the recycled ferrous metallic abrasive fail to meet the requirements of Sections 4.1, 4.2, 4.3, or 4.4, it must be recleaned until it meets these requirements.

## 5. Testing Procedure

**5.1 PROCEDURE FOR DETERMINING NON-ABRASIVE RESIDUE IN WORK MIX**

**5.1.1** Collect a minimum of three representative samples (approximately 450 grams [1 lb] each) of the work mix. The three samples shall be collected at three different times during each reclamation cycle, or during an 8-hour period.

**5.1.2** Combine the samples collected as described in Section 5.1.1 and split into approximately 115 g (1/4 lb) samples.

**5.1.3** Add approximately 115 g (1/4 pound) to a 203 mm (8-inch) diameter #100 sieve, per ASTM E 11, and screen the abrasive for one minute.

Provided by : www.spic.ir Licensee: NISOC Library

**5.1.4** Spread the screened portion (>#100 sieve per ASTM E 11) over a clean surface of approximately 0.1 $m^2$ (1 $ft^2$ ).

**5.1.5** Place a magnet in a plastic sheath or cylinder as shown in Figure 1. The magnet must be in contact with the bottom of the interior surface of the plastic sheath.

**5.1.6** Place the sheathed magnet in contact with the screened portion of the abrasive. Note: Care must be taken not to pick up too much magnetic material at one time. Non-magnetic particles can get trapped in the magnetic particles.

**5.1.7** While keeping the magnet in contact with the interior surface of the plastic sheath, move the sheathed magnet over a pre-weighed collection vessel.

**5.1.8** Raise the magnet from the bottom of the plastic sheath, thus depositing the collected magnetic fraction into the pre-weighed collection vessel.

**5.1.9** Return the sheathed magnet to the screened portion of the abrasive and repeat steps described in Sections 5.1.7 and 5.1.8 until no more magnetic material is retrieved from the screened portion of the abrasive.

**5.1.10** Combine the non-magnetic residue remaining after the procedure described in Section 5.1.4 and <#100 sieve fines from the procedure described in Section 5.1.3 and weigh to the nearest 0.05 g. If the combined weight of non-magnetic material plus <#100 sieve fines is greater than 1% of the total weight of the initial sample from Section 5.1.3, then the working mix should shall be recleaned until it meets the requirement of Section 4.1.

**5.2 LEAD CONTENT:** A representative sample of cleaned, work mix ferrous metallic abrasive shall be tested for lead in accordance with ASTM D 3335.

**5.3 WATER SOLUBLE CONTAMINANTS:** A representative sample of cleaned, work mix ferrous metallic abrasive shall be tested for conductivity in accordance with ASTM D 4940.

**5.4 OIL CONTENT:** Examine the solution used in Section 5.3 before filtering. There shall be no presence of oil either on the surface of the water or as an emulsion.

## 6. Quality Control

**6.1** The testing for non-abrasive residue (Section 4.1), water soluble contaminants (Section 4.3) and oil content (Section 4.4) shall be performed and documented daily unless otherwise specified or agreed upon between the contracting parties.

**6.2** The testing for total lead content of the work mix using the method defined in Section 5.2 shall be performed weekly unless otherwise specified or agreed upon between the contracting parties. Alternately, testing frequency can be based on operating hours or number of abrasive recycles. For new steel, or if the steel is not covered with a lead-based paint, Section 5.2 may be disregarded.

## 7. Health and Safety Requirements

**7.1** The abrasive material as supplied shall comply with all applicable federal, state and local regulations.

**7.2** Material Safety Data Sheets shall be furnished for all abrasive materials supplied.

**7.3** When lead or other hazardous materials are being removed, special precautions are needed to protect the workers and to avoid exceeding the permissible exposure limits (PEL) for the hazardous dust.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC specifications is as accurate, complete and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials or methods specified therein, or of the specification itself.

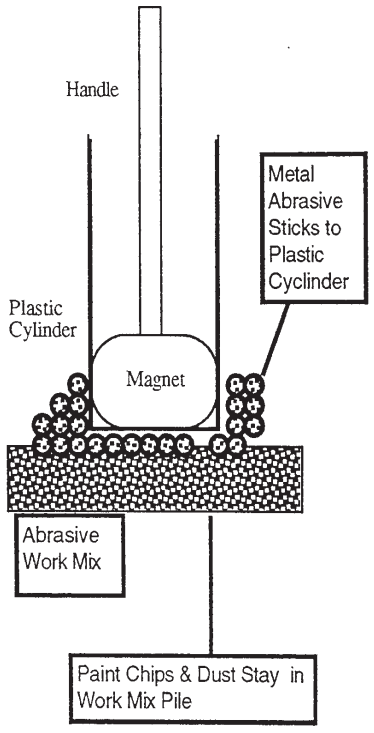



**Figure 1: Separating Metallic Abrasive from the Work-Mix Using a Sheathed Magnet.**

Provided by : www.spic.ir Licensee: NISOC Library

## 9. Notes

Notes are not requirements of this specification.

**9.1** The limitation for abrasive conductivity is based on pressure immersion testing and accelerated outdoor exposure tests performed by SSPC and the National Shipbuilding Research Program.

**9.2** Because spent abrasives may contain hazardous paint and other foreign matter, disposal of abrasives shall be performed in compliance with all applicable federal, state, and local regulations.

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC: The Society for Protective Coatings

# ABRASIVE SPECIFICATION NO. 3

## Newly Manufactured or Re-Manufactured Steel Abrasives

## 1. Scope

**1.1** This specification covers the requirements for newly manufactured steel abrasive or re-manufactured steel abrasive for use in surface preparation by blast cleaning.

**1.2** This specification does not cover recycled steel abrasive processed through field or shop abrasive blast cleaning units. Requirements for recycled steel abrasives are covered in SSPC-AB 2, Specification for Cleanliness of Recycled Ferrous Metallic Abrasives.

**1.3** Steel abrasives covered by this specification are intended for the removal of rust, mill scale, paint or other surface coating system, or for general blast cleaning.

## 2. Description

**2.1** Steel abrasives can have two basic particle shapes: spherical or round for shot and angular or irregular for grit, as defined in Sections 4.3.3.1 and 4.3.3.2.

**2.2** The size designations and specifications for steel shot and grit are given in Tables 1 and 2 of this specification. Also see Note 7.4.

**2.3 DEFINITIONS**

**New Steel Abrasives:** Abrasive material not previously used for blast cleaning and produced from newly manufactured steel.

**Recycled/Reclaimed Steel Abrasives:** Used steel abrasives recovered from blasting operations and processed through field or shop abrasive cleaning units.

**Re-Manufactured Steel Abrasives:** Steel abrasives produced from reclaimed steel abrasives at a fixed manufacturing facility regularly engaged in this work.

## 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

**3.3** If there is a conflict between the requirements of any of the cited reference standards and this specification, the requirements of this specification shall prevail unless otherwise specified in the contract.

**3.4 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **C 128** | Test Method for Specific Gravity |
| **C 136** | Test Method for Sieve Analysis of Fine Sand and Coarse Aggregates |
| **D 4940** | Test Method for Conductimetric Analysis of Water Soluble Ionic Contaminants of Blasting Abrasives |
| **E 11** | Specification for Wire-Cloth Sieves for Testing Purposes |
| **E 29** | Standard Practice for Using Digits in Test Data to Determine Conformance with Specifications |
| **E 140** | Hardness Conversion Tables for Metals |
| **E 350** | Standard Test Method for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron and Wrought Iron |
| **E 384** | Test Methods for Microhardness of Materials |

**3.5 SSPC STANDARD:**

| | |
|---|---|
| **AB 2** | Specification for Cleanliness of Recycled Ferrous Metallic Abrasives |

**3.6 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO) STANDARD:**

| | |
|---|---|
| **11124-3** | High Carbon Cast Steel Shot and Grit |

**3.7 SAE STANDARD:**

| | |
|---|---|
| **J444** | Cast Shot and Grit Size Specification for Cleaning |

## 4. Requirements

**4.1 ABRASIVE SELECTION:** The owner/specification writer shall define, based on the requirements listed below, abrasive shape, size and hardness to meet the job requirements.

Provided by : www.spic.ir Licensee: NISOC Library

## TABLE 1
## Steel Shot Size Specifications

| Screen No. ASTM E 11 | Screen Opening (inches)* | SHOT SIZE 780 | 660 | 550 | 460 | 390 | 330 | 280 | 230 | 170 | 110 | 70 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 0.111 | all pass | — | — | — | — | — | — | — | — | — | — |
| 8 | 0.0937 | — | all pass | — | — | — | — | — | — | — | — | — |
| 10 | 0.0787 | 85% min** | — | all pass | all pass | — | — | — | — | — | — | — |
| 12 | 0.0661 | 97% min | 85% min | — | 5% max | all pass | — | — | — | — | — | — |
| 14 | 0.0555 | — | 97% min | 85% min | — | 5% max | all pass | — | — | — | — | — |
| 16 | 0.0469 | — | — | 97% min | 85% min | — | 5% max | all pass | — | — | — | — |
| 18 | 0.0394 | — | — | — | 96% min | 85% min | — | 5% max | all pass | — | — | — |
| 20 | 0.0331 | — | — | — | — | 96% min | 85% min | — | 10% max | all pass | — | — |
| 25 | 0.028 | — | — | — | — | — | 96% min | 85% min | — | 10% max | — | — |
| 30 | 0.0232 | — | — | — | — | — | — | 96% min | 85% min | — | all pass | — |
| 35 | 0.0197 | — | — | — | — | — | — | — | 97% min | — | 10% max | — |
| 40 | 0.0165 | — | — | — | — | — | — | — | — | 85% min | — | all pass |
| 45 | 0.0138 | — | — | — | — | — | — | — | — | 97% min | — | 10% max |
| 50 | 0.0117 | — | — | — | — | — | — | — | — | — | 80% min | — |
| 80 | 0.007 | — | — | — | — | — | — | — | — | — | 90% min | 80% min |
| 120 | 0.0049 | — | — | — | — | — | — | — | — | — | — | 90% min |

* Screen opening sizes and screen numbers with maximum and minimum cumulative percentages allowed on corresponding screens.
NOTE: These sizes correspond to those in SAE J444 Cast Shot and Grit Size Specifications for Cleaning.
** All percentages refer to weight percent.

## TABLE 2
## Steel Grit Size Specifications

| Screen No. ASTM E 11 | Screen Opening (inches)* | GRIT SIZE G12 | G14 | G16 | G18 | G25 | G40 | G50 | G80 | G120 |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 0.0937 | all pass | — | — | — | — | — | — | — | — |
| 10 | 0.0787 | — | all pass | — | — | — | — | — | — | — |
| 12 | 0.0661 | 80%** | — | all pass | — | — | — | — | — | — |
| 14 | 0.0555 | 90% | 80% | — | all pass | — | — | — | — | — |
| 16 | 0.0469 | — | 97% | 75% | — | all pass | — | — | — | — |
| 18 | 0.0394 | — | — | 85% | 75% | — | all pass | — | — | — |
| 25 | 0.0280 | — | — | — | 85% | 70% | — | all pass | — | — |
| 40 | 0.0165 | — | — | — | — | 80% | 70% | — | all pass | — |
| 50 | 0.0117 | — | — | — | — | — | 80% | 65% | — | all pass |
| 80 | 0.0070 | — | — | — | — | — | — | 75% | 65% | — |
| 120 | 0.0049 | — | — | — | — | — | — | — | 75% | 60% |
| 200 | 0.0029 | — | — | — | — | — | — | — | — | 70% |

* Screen opening sizes and screen numbers with minimum cumulative percentages allowed on corresponding screens.
NOTE: These sizes correspond to those in SAE J444 Cast Shot and Grit Size Specifications for Cleaning.

** All percentages refer to weight percent.

Provided by : www.spic.ir Licensee: NISOC Library

**4.2 GENERAL PHYSICAL AND CHEMICAL PROPERTIES:** The abrasive shall meet the size requirements for each size specified as defined in Table 1 for steel shot or Table 2 for steel grit.

**4.3 PHYSICAL PROPERTIES**

**4.3.1 Size Classification:** The abrasive shall be tested in accordance with Section 5.2.1 and shall meet the size requirements for each size specified as defined in Table 1 for steel shot or Table 2 for steel grit.

**4.3.2 Hardness:** This specification defines two ranges of abrasive hardness: Rockwell C 50 and lower and Rockwell C 51 and higher. Steel abrasive hardness shall be tested in accordance with Section 5.2.4. Other hardness ranges between 35 and 65 on the Rockwell C scale are available and may be specified in the bid documents. (See Notes 7.2 and 7.6.)

**4.3.3.1 Steel Shot:** Using a 10X microscope or magnifying glass, steel shot shall be predominantly rounded particles with no more than 10% elongated particles. (An elongated particle is one with a length more than twice its diameter.)

**4.3.3.2 Steel Grit:** Using a 10X microscope or magnifying glass, steel grit shall be irregular and angular shaped, with no more than 10% round or half-round particles.

**4.3.4 Specific Gravity:** When tested in accordance with Section 5.2.2, the specific gravity of the steel abrasives shall be no less than 7.0.

**4.3.5 Durability:** When steel abrasives are tested for durability in accordance with Section 5.2.5, after 100 cycles in the durability test, no more than 20% by weight of the abrasive shall pass through the appropriate take-out screen as defined in Table 3 for grit or in Table 4 for shot.

**4.4 CHEMICAL PROPERTIES**

**4.4.1 Chemistry:** When tested in accordance with Section 5.2.3, the chemical composition of the steel abrasive shall conform with Table 5.

**4.4.2 Conductivity:** When tested in accordance with Section 5.2.7, the conductivity of the solution of water soluble contaminants shall not exceed 1000 μmho/cm.

**4.4.3 Cleanliness:** When tested in accordance with Section 5.2.6, the steel abrasive shall be free of dust, grease, corrosion, non-magnetic matter subject to the limitations in Sections 4.4.3.1 and 4.4.3.2, and other contaminants. The presence of rust in excess of a slight red or blue oxidation of the abrasive particle shall be cause for rejection.

**TABLE 3**
**Steel Grit Take-Out Screens**

| Steel Grit Size | Take-Out Screen Size |
|---|---|
| G12 | 40 mesh |
| G14 | 40 mesh |
| G16 | 40 mesh |
| G18 | 40 mesh |
| G25 | 50 mesh |
| G40 | 50 mesh |
| G50* | 70 mesh |
| G80* | * |
| G120* | * |

* Abrasive sizes G50, G80, and G120 cannot be accurately tested due to limitations of the test apparatus in retaining fine abrasives

**TABLE 4**
**Steel Shot Take-Out Screens**

| Steel Shot Size | Take-Out Screen Size |
|---|---|
| S780 | 40 mesh |
| S660 | 40 mesh |
| S550 | 40 mesh |
| S460 | 40 mesh |
| S390 | 40 mesh |
| S330 | 50 mesh |
| S280 | 50 mesh |
| S230 | 50 mesh |
| S170 | 50 mesh |
| S110* | 70 mesh |
| S70* | * |

* Shot sizes S110 and S70 cannot be accurately tested due to limitations of the test apparatus in retaining these sizes

**TABLE 5**
**Steel Abrasive Chemistry**

| Element | Percent by Weight |
|---|---|
| Iron | 95.00% minimum |
| Carbon | 1.50% maximum |
| Manganese | 1.20% maximum |
| Phosphorous | 0.05% maximum |

Provided by : www.spic.ir Licensee: NISOC Library

**4.4.3.1 Accept:** If the sample has less than or equal to 0.2% by weight of non-magnetic matter and no oil film or slick on the surface of the water (clouding or discoloration of the water is not grounds for rejection).

**4.4.3.2 Reject:** If the sample has more than 0.2% by weight of non-magnetic matter or there is an oil film or slick on the surface of the water and sides of the container.

## 5. Quality Assurance Test Methods

**5.1 RESPONSIBILITIES FOR TESTING:** Unless otherwise specified, the supplier is responsible for performing and documenting the preliminary acceptance tests and inspections called for in this specification. The procurement documents should establish the specific responsibilities for conformance testing.

**5.2 TEST PARAMETERS:** Unless otherwise specified in the contract or purchase order, the supplier shall be responsible for compliance with the requirements for size, durability, cleanliness, specific gravity, chemical composition, hardness, and conductivity.

**5.2.1 Size:** The abrasive sizing shall be tested in accordance with ASTM C 136.

**5.2.2 Specific Gravity:** Specific gravity shall be determined in accordance with ASTM C 128.

**5.2.3 Chemical Composition:** Chemical composition shall be determined in accordance with ASTM E 350.

**5.2.4 Hardness:** Hardness values shall be obtained in accordance with ASTM E 384 utilizing a microhardness tester with a 500 g load. Measurements taken in Knoop hardness numbers shall be converted to Rockwell C Scale.

**5.2.4.1** Metallic abrasives sometimes contain internal shrinkage, voids, or inclusions which remain undetected beneath the surface in a mounted and polished sample. These characteristics can cause a non-uniform hardness reading and shall be ignored when testing for hardness.

**5.2.5 Durability Testing**

**5.2.5.1 Procedure**

1. Obtain a representative sample and weigh out 100 grams (± 0.1 g) of new abrasive.

2. Place 100 g sample in a calibrated standard durability test machine (see Section 5.2.5.2) and run for 100 passes.

3. Remove sample from test machine and screen sample on appropriate take-out screen (see Table 3 for grit, Table 4 for shot).

4. Hand screen sample on take-out screen and record weight.

**5.2.5.2 Apparatus:** Durability tests shall be performed using an Ervin Test Machine or equivalent shot/grit test machine, properly calibrated in accordance with the manufacturer's instructions.

**5.2.6 Abrasive Cleanliness**

1. Obtain a representative sample.

2. Weigh out 100 grams ± 1 gram.

3. Magnetically remove all magnetic material.

4. Weigh remaining non-magnetic material and record weight. Discard non-magnetic material.

5. Check magnetic material for rust in excess of slight red or blue oxidation.

6. Place magnetic material in a glass jar and cover with at least one inch of potable water.

7. Vigorously shake the jar containing water and magnetic material.

8. After shaking, observe water surface in jar as described in Sections 4.4.3.1 and 4.4.3.2.

**5.2.7 Conductivity:** Conductivity tests shall be run in accordance with ASTM D 4940.

## 6. Disclaimer

**6.1** While every precaution is taken to ensure that all information furnished in SSPC specifications is as accurate, complete and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, paints, or methods specified therein, or of the specification itself.

## 7. Notes

Notes contain supplementary information and are not considered part of the specification.

**7.1 ABRASIVE DISPOSAL:** The disposal of spent abrasives should be in compliance with all applicable federal, state, and local regulations. It should be noted that the

Provided by : www.spic.ir Licensee: NISOC Library

spent abrasive may contain hazardous paint and other foreign matter.

**7.2 ABRASIVE HARDNESS:** Abrasive hardness may affect performance of steel abrasives as follows:

**Rockwell C-51 and higher hardness**

- Increasing hardness increases cutting rate compared to abrasives with hardnesses below C-51, particularly when removing live (i.e., soft, flexible) coating systems.
- Increased surface profile compared to abrasives with hardnesses below C-51.
- Lower durability, increased abrasive consumption compared to abrasives with hardnesses below C-51.

**Rockwell C-50 and lower hardness**

- Good cutting rate for new steel and most coating systems.
- Lower profile compared to abrasives with hardnesses of C-51 and higher.
- Higher durability but greater tendency to rounding compared to abrasives with hardnesses of C-51 and higher.

**7.3 ABRASIVE SHAPE:** Abrasive shape may affect performance and profile produced for subsequent new coating as follows:

- Steel shot generally produces a rounded profile and is effective in removing mill scale.
- Steel grit generally produces a deeper, angular profile and is more effective for the removal of existing coating systems and rust.

**7.4 ABRASIVE PRODUCTIVITY:** For greatest productivity, always use the finest size shot or grit that will effectively clean the surface and produce the proper profile. Abrasive recycling machines should be set to retain all usable shot or grit sizes in the working mix for maximum productivity and lowest abrasive consumption.

**7.5 ABRASIVE DURABILITY:** Abrasive durability is based on laboratory conditions using test equipment. Actual results under field conditions will vary.

**7.6 ABRASIVE CHANGE WITH USE:** This specification has been developed for newly manufactured or remanufactured abrasives. With use, abrasive hardness, particle size, and particle shape will vary depending on initial hardness, blasting velocity, and blasting method. Abrasive hardness will increase with continued reuse. Abrasive shape will become more rounded with continued reuse. Abrasive size will decrease with continued reuse. Because of changes in hardness, shape, and size, it is important that new abrasives are added to the work mix on a regular basis to ensure quality and consistency of blast profile and cleanliness.

**7.7 FOR MORE INFORMATION:** Also see "Good Painting Practice," Volume 1 of the SSPC Painting Manual, for more information.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS COM
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# COMMENTARY ON PAINTING SYSTEMS

## 1. Introduction

SSPC has three types of painting system documents: complete painting systems, painting system guides, and performance based painting system material specifications.

• Painting System: Each of these painting systems combines in a single specification all of the requirements necessary for a complete paint job. It therefore includes by reference all of the specifications for surface preparation, paint application, paint thickness measurement, primer, midcoat, topcoat, safety, and inspection. In most cases it is recommended that the particular painting system is specified by number.

• Painting System Guides: The painting system guides are to be used to prepare modified systems for special cases. Unlike the other guides in this section, SSPC-Guide 8.00 does not address the surface preparation of a steel substrate, but rather provides guidance in selecting the proper topcoat for use over a zinc-rich primer.

• Painting System Material Specifications – Performance-Based: These documents specify the performance requirements for a multi-coat system based on a particular generic class of coatings, e.g., aluminum epoxy. These documents serve only to qualify a coating material and do not address other items such as surface preparation and thickness measurement. Hence, these painting system material specifications serve only to specify the coating material to be used in a complete painting system specification.

By disregarding the more unusual combinations and circumstances, the SSPC Painting Systems are able to offer in complete but compact form the minimum number of combinations necessary to paint the great preponderance of steel structures. For unusual circumstances, the user of the specifications may devise his own painting systems by choosing from among the alternative specifications listed in the Painting System Guides. These models offer a large number of compatible combinations of surface preparations, primers, intermediates, and finish paints.

SSPC Painting Systems and Guides were originally published in 1955. They were revised and expanded to incorporate improvements in concept and in technology. The Painting System Material Specifications – Performance Based were first introduced in 2000. The descriptions of painting systems are listed in Table 1. Within each generic type, there may be several systems, each a complete paint scheme in itself. Each scheme is designed for a specific application where a particular combination of durability, drying time, tolerance for surface preparation, cost, color, etc., is desired.

## 2. Using SSPC Painting Systems by Number

The preferred method of using the SSPC Painting Systems is simply to specify, for example, that the steel or the structure shall be painted in accordance with the SSPC-PS 1.09 “Three Coat Oil Base Zinc Oxide Painting System.” This is similar to the procedure that would be used in specifying the steel.

By using this method, the specifier can procure a standard painting system consisting of a surface preparation suitable for the priming paint; the specification for an intermediate coat (sometimes a primer or topcoat tinted to contrasting shade); usually one standard finish coat, often offering an option of colors and a specified thickness for each coat. Use of the standard painting system will generally result in satisfactory performance if the recommendations are followed.

Within each general type of painting system (Table 1) an exceedingly large number of combinations would be possible. As an aid in selecting a specific system for a specific need, some general types are divided into a limited number of proven SSPC Painting Systems. (See Tables 2 through 4 of this commentary and the descriptions accompanying them.)

## 3. Using SSPC Painting System Guides

Rather than using the SSPC Painting System Specifications, the specifier may wish to employ the SSPC Painting System Guides. These worksheets (or models) are useful for special painting problems not covered by the standard painting systems. To use them, one first decides what generic type of coating is to be used — oil base, alkyd, vinyl, coal tar, etc. For each of these types there is usually a corresponding painting system guide. For example, the oil base painting system guide is numbered SSPC-PS Guide 1.00, the alkyd 2.00, the phenolic 3.00 and the vinyl 4.00. In these guides are descriptions of each specification, including the principal public specifications of SSPC, the government, the American Association of State Highway and Transportation Officials (AASHTO), and others. A complete painting system can therefore be made up by choosing, from one of these worksheets, the desired stipulations on surface preparation, application, primer, topcoat, etc.

By using this alternative, painting systems may be prepared to cover special requirements. It should be emphasized, however, that judgment must be used in selecting the proper painting systems, the surface preparations,

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**OUTLINE OF SSPC PAINTING SYSTEMS AND GUIDES**

| System Number | Code | Description |
|---|---|---|
| 1 | SSPC-PS 1.00-1.13 | Oil Base Painting Systems |
| 2 | SSPC-PS 2.00-2.05 | Alkyd Painting Systems |
| 3 | SSPC-PS 3.00 | Phenolic Painting Systems |
| 4 | SSPC-PS 4.00-4.04 | Vinyl Painting Systems |
| 7 | SSPC-PS Guide 7.00 | Guide for Selecting One-Coat Shop Painting Systems |
| 8 | SSPC-PS Guide 8.00 | Guide to Topcoating Zinc-Rich Primers |
| 9 | SSPC-PS 9.01 | Cold-Applied Asphalt Mastic Painting System with Extra Thick Film |
| 10 | SSPC-PS 10.01-10.02 | Hot- and Cold-Applied Coal Tar Painting Systems |
| 11 | SSPC-PS 11.01 | Black (or Dark Red) Coal Tar Epoxy Polyamide Painting System |
| 12 | SSPC-PS 12.00-12.01 | Zinc-Rich Painting Systems |
| 13 | SSPC-PS 13.01 | Epoxy Polyamide Painting System |
| 14 | SSPC-PS 14.01 | Steel Joist Shop Painting System |
| 15 | SSPC-PS 15.00-15.04 | Chlorinated Rubber Painting System |
| 16 | SSPC-PS 16.01 | Silicone Alkyd Painting System for New Steel |
| 17 | SSPC-PS Guide 17.00 | Guide for Selecting Urethane Painting Systems |
| 18 | SSPC-PS 18.01 | Three-Coat Latex Painting System |
| 19 | SSPC-PS Guide 19.00 | Guide for Selecting Painting Systems for Ship Bottoms |
| 20 | SSPC-PS Guide 20.00 | Guide for Selecting Painting Systems for Boottoppings |
| 21 | SSPC-PS Guide 21.00 | Guide for Selecting Painting Systems for Topsides |
| 22 | SSPC-PS Guide 22.00 | Guide for Selecting One-Coat, Pre-Construction or Pre-Fabrication Painting Systems for Ships |
| 23 | SSPC-CS 23.00(I) | Interim Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel |
| 24 | SSPC-PS 24.00 | Latex Painting System for Industrial and Marine Atmospheres, Performance-Based |
| 26 | SSPC-PS 26.00 | Aluminum Pigmented Epoxy Coating System for Steel Surfaces, Performance-Based |
| 27 | SSPC-PS 27.00 | Alkyd Coating System, Performance-Based |

and priming and finish paints. The recommended systems are completely compatible and should result in satisfactory paint life from both the protective and decorative viewpoint. Volume 1 of the SSPC Manual should also be consulted for further detailed information.

The painting systems are occasionally used in a third way. This method is similar to the preceding one, but the user may vary any of the surface preparations, primer, etc., that are listed by substituting proprietary products or other specifications as he desires. A painting system is then a model for the preparation of the user's own painting system, which may be more suitable for his particular requirements. Here, the user must be extremely careful that compatible surface preparations, paints, and methods are specified. The use of proprietary priming and finish paints is highly recommended provided the user has sufficient experience to know that they will perform satisfactorily.

## 4. Using SSPC Painting System Material Specifications – Performance-Based

These specifications are used to specify only the coating material, i.e., the paints, in a complete painting system specification. One of the SSPC Painting Systems or Painting System Guides can be used as a template in preparing the job specification incorporating the performance based coating material specification. This approach allows the coating manufacturer to custom match each coat of a multicoat system with the adjacent coating layer.

## 5. Limitations

The use of specifications alone cannot guarantee performance; neither can strict compliance with the recommendations of the specifications prevent all future paint failures. For example, when hand cleaning is used as a method of surface preparation, it is impossible to guarantee that there will be no lifting of millscale. Even when blast cleaning is used as a method of surface preparation, and the proper paints are used, paints may fail due to the great number of factors that cannot be controlled in every case. One can be safely assured, however, that if this good practice has been followed, the possibility of failure is

Provided by : www.spic.ir Licensee: NISOC Library

reduced to the minimum consistent with the present state of the art.

Regulations governing the content of volatile organic compounds (VOC) of coatings vary from state to state and among districts within a state. Before choosing a painting system it is therefore imperative that all applicable federal, state, and local regulations and restrictions are known so that the appropriate surface preparation and coatings can be specified.

## 6. Summary of SSPC Painting Systems

**6.1 OIL BASE PAINTING SYSTEMS (NO. 1):** Oil base painting systems are summarized in Table 2, which shows five basic oil base paint systems. These are numbered SSPC-PS 1.04, 1.09, 1.10, 1.12, and 1.13. For special paint problems not covered by the standard paint systems, an oil base painting system guide SSPC-PS Guide 1.00 is also presented.

**6.1.1 Use:** The oil base painting systems do not necessarily require complete removal of intact mill scale by blast cleaning or pickling. However, thorough surface preparation by hand tool or power tool cleaning is mandatory. The primers in these systems are based chiefly upon linseed oil vehicles with good surface wetting properties and upon rust-inhibitive pigmentation.

These painting systems are intended primarily for structural steel exposed to atmospheric conditions. They are particularly suitable for outdoor weather exposure, but may also be used for the interior of buildings subjected to moderately corrosive conditions. They have only limited resistance to chemical exposure, immersion, brine, condensation, high humidity, burial, very corrosive environments, high temperatures, or abrasion. Blast cleaning or pickling may be used to prolong expected paint life, to counteract severe exposures, or to assure adequate cleaning of badly rusted steel surfaces.

These painting systems have been used successfully on a wide variety of weather-exposed structural steel constituting the major surface areas of many structures. They are satisfactory for structural steel in industrial, rural, or mild marine atmospheres. Typical structures are highway, railroad, and ore bridges; tank exteriors; building exteriors; interiors exposed to occasional condensation and fumes; bandstands, grandstand frames, and platforms; bin exteriors; belt conveyors; unheated parts of blast furnaces; catenary poles and towers; industrial plant yard areas; cranes, derricks, runways, and heavy equipment; dock and dam superstructures; fences, posts, guard rails, iron railings; fire escapes, door frames, window sills and coamings.

**6.1.2 Description:** Primer vehicles made up of raw linseed oil only are very slow drying (at least 48 hours to handle). Additions of boiled oil reduce the drying time but also reduce the wetting efficiency. Additions of alkyd resins further reduce the drying time but also reduce the wetting efficiency. Inhibitive pigments help retard corrosion. Other pigments enhance the functionality (hardness, UV stability, etc.) of the coating.

Each of these oil base painting systems represents a proven combination selected for specific properties and uses. System PS 2.05 provides some alkyd in the primer and is especially good for steel that is thoroughly wire brushed. System PS 1.04 is, with the precautions indicated, an excellent system for galvanized steel with more tolerance for rust than the equivalent alkyd system PS 2.05. Systems PS 1.09 and 1.10, three and four coat systems, respectively, use zinc oxide primers that are free of lead and chromate pigments.

**6.2 ALKYD PAINTING SYSTEMS (NO. 2)**

**6.2.1 Use:** Alkyd painting systems are satisfactory for structural steel in industrial, rural, or marine atmospheres, particularly those that are too severe for oil base paints, such as high humidity, industrial fumes, etc. Typical structures are plants and refineries; moderately heated parts of blast furnaces; industrial buildings; chemical plants, yard areas or mild interiors; interiors of buildings of high humidity but not continuous condensation; bins, belt conveyors, platforms; grandstands; highway, railroad, and ore bridges; dam and dock superstructures; topsides and superstructures of vessels; cranes and derricks; guard posts and rails; railings.

Alkyd painting system may be used for production items such as siding, door and window frames and sash, or for equipment used in highway construction, mining, and excavating. For such items, hot phosphate pretreatment or wash primer is recommended. Colored high gloss enamel finishes may be selected from TT-E-489, semi-gloss from TT-E-529. Where conditions are more severe than normally encountered, or faster drying topcoats are desired, alkyd finish paints should be selected rather than oil paints.

Generally, linseed oil paints or alkyds are not considered satisfactory for continuous water immersion. However, if several months are allowed for such paints to dry before immersion, they will perform much better, particularly if phenolic topcoats are used.

When very short oil alkyds are specified for use over softer paints, it is important that at least a week be allowed before application of the alkyd paint.

A performance based alkyd system is described in PS 27.00.

**6.2.2 Description:** Alkyd painting systems are intended primarily for structural steel exposed to atmospheric conditions, but they may be used for infrequent immersion in fresh or salt water, or infrequent exposure to condensation. They are particularly suited for severe weather exposure, but they may be also be used for the interiors of buildings subjected to corrosive conditions such as mild

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**OIL BASE PAINTING SYSTEMS (for weather-exposed, wire-brushed steel)**

| | **SSPC 1.09** zinc oxide primer | **SSPC-PS 1.10** zinc oxide primer | **SSPC-PS 1.12*** zinc chromate primer | **SSPC-PS 1.13** slow drying maintenance |
|---|---|---|---|---|
| **Min. Surface Prep.** | SSPC-SP 2, Hand-Tool Cleaning | | | |
| **Paint Application** | SSPC-PA 1 | | | |
| **No. of Coats** | 3 | 4 | 3 | 1 |
| **First Coat** | SSPC-Paint 25 | SSPC-Paint 25 | SSPC-Paint 11 | SSPC-Paint 26 |
| **Touch-Up** | SSPC-PA 1 | | | |
| **Second Coat** | SSPC-Paint 104, White or Tinted Alkyd Paint | SSPC-Paint 25 | SSPC-Paint 104 | None |
| **Third coat** | SSPC-Paint 104, White or Tinted Alkyd Paint | | | None |
| **Fourth coat** | None | SSPC-Paint 104 | None | None |
| **Alternate finish coat** | SSPC-Paint 101, Aluminum Alkyd Paint**; or SSPC-Paint 108, High-Build Thixotropic Leafing Aluminum Paint*** | | | None |
| **Minimum dry film thickness** | Primer–50 $\mu$m (2 mils) System–115 $\mu$m (4.5 mils) | Primer–50 $\mu$m (2 mils) System–115 $\mu$m (4.5 mils) | Primer–50 $\mu$m (2 mils) System–115 $\mu$m (4.5 mils) | 100 $\mu$m (4 mils) |
| **Color** | Varies | Varies | Varies | Black |
| **Drying time (max at 21°C/70°F)** | 18 to 24 hours (recoat); Alternate Finish – 10 hours (hard) | | | 168 hours (hard) |
| **Recommended/Not Recommended****** | | | | |
| **Rural** | R | R | R | R |
| **Industrial (mild)** | R | R | R | R |
| **Marine (mild)** | R | NR | NR | NR |
| **Humidity & condensation** | NR | NR | NR | NR |
| **Dry interior** | R | R | R | R |

* This system includes chromate containing pigments.
**If this alternate finish coat is used, then the intermediate coat shall consist of one coat of SSPC-Paint 101, Alkyd Aluminum Paint, Type II, Non-Leafing.
***If this alternate finish coat is used, then no intermediate coat shall be required, but the dry film thickness shall not be less than 50 $\mu$m (2.0 mils) for the finish coat and 115 $\mu$m (4.5 mils) for the painting system.
****Oil base systems are not recommended for fresh or salt water immersion, chemical, or underground chemical exposure, high humidity, or infrequent condensation. They have only limited resistance to strongly chemical environments, complete immersion, burial, or severe abrasion. Because of the reduced performance of the primers on dirty, oily, or rusting steel, it is recommended that blast cleaning or pickling of steel be used as the surface preparation for new work.

**6.3 PHENOLIC PAINTING SYSTEMS (SSPC-PS GUIDE 3.00)**

**6.3.1 Use:** Phenolic painting systems are used for structural steel surfaces that will be immersed in fresh water or exposed to alternate immersion, high humidity and condensation, or to the weather or moderately severe chemical atmospheres.

Provided by : www.spic.ir Licensee: NISOC Library

When properly manufactured and applied they have proven excellent in these applications, but in other cases, performance has proven erratic, particularly in intercoat adhesion. For this reason, no standard SSPC phenolic paint systems have been prepared; for the many special cases where phenolic systems are still desired, however, the phenolic painting system guide is presented (SSPC-PS Guide 3.00).

Air-drying phenolic paints are used for moderately severe chemical atmospheres that are neither strongly alkaline nor strongly acidic and for exposure to brine or salt water with proper selection of primer and topcoats. Because of the reduced performance of the primers on dirty, oily, or rusting steel, blast cleaning or pickling of the steel is the recommended surface preparation for new work.

Typical uses are for fresh water vessels and barges; aeration and humidifying equipment; antisweat coatings; buildings exposed to high humidity and condensation such as laundries, bottling plants, dairies, beer cellars; ballast tanks; water tanks and standpipes; bridges; docks and dams; caissons; dam and flood gates; drydocks and pontoons; decks; water and sewage plants; chemical plants, but not usually for immersion in strong chemicals.

**6.3.2 Description:** Sand embedded in the second coat of paint (first intermediate coat) when still wet adds greatly to the abrasion resistance and the life of phenolic painting systems. The surface should be blast cleaned and primed in the usual manner. A second coat of primer is then applied about one third thicker than customary. A heavy uniform course of sand is thoroughly and uniformly embedded within a few minutes after application of the paint and before it has set sufficiently to prevent embedment. The building up of layers of imperfectly embedded sand is to be avoided. The sand should be applied in sufficient volume to provide an essentially continuous layer, one particle in thickness, without appreciable distance between sand grains. After embedment, the paint is allowed to dry for two days; the loose sand is removed by brushing or blown off with air. The remaining coats of the paint system are then applied at a wet film thickness to cover the individual grains of sand, but not to eliminate the valleys between grains.

**6.3.3 Recoating:** When phenolic paints are specified for use over oil base or alkyd paints, it is particularly important that the undercoat be sufficiently dry for such recoating. Where priming occurs in the field, at least a week should be allowed before application of the phenolic paint. At that time, if experience with the system is limited, the condition of the priming paint should be tested by making a spot trial with the phenolic paint applied in a heavy wet coat over several square feet of area. If no wrinkling, loosening or lifting of the undercoat has occurred after 24 hours, and if adhesion is good, then the undercoat is dried sufficiently for repainting.

When the phenolic paints are to be applied over phenolic paints, the underlying phenolic paint may be too hard for the following phenolic paint to develop proper adhesion. This difficulty is usually eliminated by applying the second coat of phenolic paint to the first coat of phenolic paint in about 24 hours. If the phenolic undercoat has been allowed to dry for more than 24 hours before recoating, then 1 percent by volume of Cellosolve or methyl isobutyl ketone should be added to the second coat of phenolic paint for every 24-hour period that the phenolic undercoat has been allowed to dry, up to a maximum of 3 percent by volume; for zinc dust-zinc oxide phenolic paint these quantities may have to be increased.

An alternative and more satisfactory procedure is to wipe the undercoat of dried phenolic paint with a solvent such as an aromatic naphtha or turpentine, or lightly abrade the area with steel wool or fine sandpaper to take the gloss off the paint but not enough to damage the paint or cut through to the undercoat or remove underlying paint.

### 6.4 VINYL PAINTING SYSTEMS (NO. 4)

**6.4.1 Use:** Vinyl painting systems are intended for very severe exposures. They are satisfactory for most of the severe chemical atmospheres; they may be used with discretion for immersion in corrosive chemicals such as inorganic acids, alkalis, and salts; or liquids such as aliphatics, alcohols, oils, grease; but they are dissolved by some organic solvents such as aromatics, ketones, ethers, and esters, and attacked by some chemicals such as fuming nitric acid, 98 percent sulfuric acid, and acetic acid.

These painting systems are recommended highly for complete or alternate immersion in fresh (including potable) or salt water, high humidity and condensation, and exposure to the weather. They are also particularly suitable for the interiors of buildings where flame resistant, mildew-free, easy to clean corrosion resistant paints are desired.

Because of the great increase in paint life, blast cleaning or pickling of the steel is the minimum recommended surface preparation for new work. In maintenance painting when only small areas need to be cleaned, hand or power tool cleaning may suffice.

Vinyl painting systems are recommended for floor systems of bridges exposed to brine drippings or deicing salts, for potable water tanks, and for most chemical exposures including dry ladings of chemicals. They are not generally recommended for constant immersion at temperatures in excess of 49°C (120°F); they may be used at temperatures up to 85°C (185°F) for atmospheric exposure, spillage, or short or infrequent immersion.

NACE International makes general observations on the chemical resistance of vinyl chloride-acetate copolymers in their report T-6B-10, “Vinyl Coatings for Prevention of Atmospheric Corrosion,” Materials Protection, Vol. 2, No. 6, pages 96-100, June 1963.

Provided by : www.spic.ir Licensee: NISOC Library

**6.4.2 Description:** The vinyl painting systems are outlined in Table 3. This table presents two specific systems and the type of exposure for which each is best. The vinyl painting system guide, SSPC-PS Guide 4.00, may be used to draw up other vinyl painting systems when special properties other than those in the standard systems are required.

Care and skill must be exercised in the application of vinyls, especially when open to the wind. In general, however, SSPC has found them unequalled in water immersion and in other recommended applications.

A wash primer improves adhesion to less than adequately prepared surfaces, and it tends to prevent corrosion creepage in salt water. The wash primer itself, however, is not as resistant to acids and alkalis as the copolymer vinyl. Reportedly, it is prone to osmotic blisters in warm, fresh water, a tendency that can be largely nullified with an aluminum topcoat. Although many users still recommend a wash primer in fresh water exposure, this practice is no longer thought to be necessary or desirable.

The profile depth of the blast cleaned surface is important to vinyl paint systems. Here the recommendations in the SSPC Surface Preparation Commentary should be followed carefully because vinyl paint life can be extended by careful surface preparation. White metal blast cleaning is often recommended for the systems, particularly Painting System 4.02 using VR-3. Because of excessive cost and difficulties reported in obtaining white metal cleaning, however, these paint systems permit the use of near-white or commercial blast cleaning as indicated.

All welds and all areas adjacent to welds must be thoroughly blast cleaned. Consult the SSPC Surface Preparation Commentary for additional details.

The proper techniques for applying vinyl paints are

**TABLE 3**
**Summary of SSPC-PS 4.02 and 4.04**
**No. 4-VINYL PAINTING SYSTEMS**
**(For Water Immersion, Industrial or Chemical Exposure)**

| Code | SSPC-PS 4.02 | SSPC-PS 4.04 |
|---|---|---|
| **Min. Surface Prep.** | SSPC-SP 10, near-white; or SP 8 pickling | SSPC-SP 6, commercial; or SP 8, pickling |
| **Wash Primer** | None required | Only if specified* |
| **Paint Application** | SSPC-PA 1, Shop Field & Maintenance Painting of Steel | SSPC-PA 1, Shop Field & Maintenance Painting of Steel |
| **Number of Coats** | 4 minimum | 4 minimum |
| **First Coat** | U.S. Bureau of Reclamation VR-3, Vinyl Resin Paint (White or Gray) | SSPC-Paint 9, White (or Colored) Vinyl Paint (tinted for contrast) |
| **Touch-Up** | SSPC-PA 1 | SSPC-PA 1 |
| **Second Coat** | VR-3 (tinted or same as fourth coat) | SSPC-Paint 9, White (or Colored) Vinyl Paint |
| **Third Coat** | Same as first coat (contrasts with second and fourth coat) | Same as first coat (contrasts with second and fourth coat) |
| **Fourth Coat** | VR-3 | SSPC-Paint 9, White (or Colored) Vinyl Paint |
| **Alternate Finish Coat (if specified)** | | SSPC-Paint 8, Aluminum Vinyl Paint**; SSPC-Paint 106, Black Vinyl Paint |
| **Minimum Dry Film Thickness (DFT)** | Primer-38 μm (1.5 mils) System-150 μm (6 mils) | Primer-30 μm (1.2 mils) System-125 μm (5 mils) |
| **Recommended for** | Fresh water immersion and for corrosive exteriors or for most inorganic chemical solutions** | Fresh water; alternate salt water immersion or weather exposure; many chemical exposures |
| **Color** | Red, white, gray, or aluminum | White, tinted, aluminum, or black |
| **Drying Time (max at 21°C/70°F)** | 3 hours (recoat) | 30 minutes (hard) |

* If specified, the wash primer SSPC-Paint 27 includes chromate containing pigments.

** The aluminum finish paint should not be used in caustic exposure nor as an intermediate or prime coat. Aluminum paint is preferred for water immersion.

Provided by : www.spic.ir Licensee: NISOC Library

given in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and in the literature of the suppliers. Airless spray and hot spray with multiple passes are helpful in obtaining proper thickness without sagging or pinholing. However, when the thickness per coat exceeds the recommended thickness by too great a margin, entrapment of solvent with subsequent pinholing may be encountered. The painter must operate close enough to the work to lay down a wet film.

Using high solids vinyl paints results in a greater film thickness per coat than is obtainable with these SSPC systems. Such paints may also have the advantage of lower cost due to less expensive resins, higher amounts of extender, and lower amounts of solvent. Nevertheless, the higher solids (and consequently greater film thickness) are obtained by using lower molecular weight resins that sacrifice some resistance and durability.

The vinyl aluminum topcoat is preferred for water immersion. It is not, however, recommended as an intermediate coat or primer in vinyl systems for application in thick films, due to the possibility of solvent entrapment. As indicated, it should not be used in caustic or strongly acid exposures.

### 6.5 ONE-COAT SHOP PAINTING SYSTEMS FOR STRUCTURAL STEEL (SSPC-PS GUIDE NO. 7.00)

**6.5.1 Use:** One-coat shop painting systems are intended for use in dry, non-corrosive environments, such as structural steel enclosed in masonry, interiors of buildings where temperature rarely falls below the dew point, or where relative humidity does not exceed 70 percent, outdoor exposure in arid climates, or temporary weather protection (less than six months) in rural or light industrial areas.

These one-coat painting systems are not expected to protect steel exposed to the weather for periods longer than six months in normal rural and mild industrial areas, and even shorter exposure periods for heavy industrial or marine exposures. These one-coat systems are intended for building frames to be enclosed in masonry or non-corrosive fireproofing, but paint should not be used if bonding of steel to concrete is required. These systems can also be used for open frames or structural steel in buildings not subjected to high humidity, condensation, or corrosive fumes; walls and partitions; floor joists and roof trusses; window and door frames; bins, ducts, chutes, conveyors, railings, platforms, runways for interiors of buildings, or exteriors where either short term protection is desired or additional painting will be undertaken.

**6.5.2 Enclosed Steelwork:** In building construction, steelwork enclosed in masonry in noncorrosive areas is sometimes left unpainted. The surface condition of such steel framing in many longstanding buildings has been excellent except in isolated spots where leakage may have occurred. Where such leakage is not eliminated, the presence or absence of a shop coat is considered of minor influence.

**6.5.3 Description:** The surface preparation for one-coat shop primers consists of hand cleaning of the steel to remove very detrimental foreign matter, loose mill scale, loose rust, accessible weld slag, and heavy deposits of oil and grease.

Proprietary primers may be specified by the purchaser or used by the fabricator if agreed upon by the purchaser.

### 6.6 TOPCOATING ZINC-RICH PRIMERS (SSPC-PS GUIDE 8.00)

**6.6.1 Use:** This guide covers the selection and application (including surface preparation) of topcoats to surfaces coated with a zinc-rich primer. Both organic and inorganic primers are included. The guide does not cover the selection and application of the zinc-rich primer.

**6.6.2 Description:** Zinc-rich primers are topcoated to provide extended exterior durability in severe exposures; to improve color, gloss, and other appearance properties; and to provide resistance to specific conditions such as highly acidic or highly basic environments. The guide contains a chart showing the degree of compatibility or non-compatibility between generic types of topcoats and zinc-rich primers.

### 6.7 ASPHALT PAINTING SYSTEM (SSPC-PS 9.01)

**6.7.1 Use:** The asphalt-cutback mastic coating system covered by SSPC Painting System 9.01 is applied cold for above-ground protection of steel structures. It is based upon application of SSPC-Paint 12, "Cold Applied Asphalt Mastic (Extra Thick Film)," to a blast cleaned or pickled surface. It is suitable for general use in corrosive or chemical atmospheres, but should not be used in contact with oils, solvents, or other reagents that tend to soften or attack it. It is intended primarily for severe atmospheric exposure such as exteriors of acid storage tanks, pickling rooms, quench tower spray areas, chemical plants, refineries, heavy-industrial plants, brine drippings, roofing, sidings, and blast plates.

**6.7.2 Description:** This system is usually applied in one heavy coat of about 1.6 mm (1/16 inch), but two thinner coats of 0.8 mm (1/32 inch) each may be substituted in order to help prevent discontinuities.

This material has no rust inhibiting characteristics and affords protection by excluding corrosive media to a high degree. It acts as a vapor seal because of its relative impermeability. In very corrosive environments it is often

Provided by : www.spic.ir Licensee: NISOC Library

used over a special rust inhibiting primer or pretreatment.

**6.7.3 Other Specifications:** In coatings, asphalt is used in four principal forms: cutbacks of asphalt with solvent; asphalt cooked with oil to form a varnish; emulsions; and pitch or filled enamel melted prior to shop application.

Asphalt emulsions have better weather durability than cutbacks and are procurable as either clay type or chemical type emulsions. Even if permitted to dry for very long periods before immersion, they give only fair protection underwater. Asphalt base emulsion may be procured under ASTM D 1227, "Emulsified Asphalt." It may be used over wash primer or rust inhibitive primers to minimize undercutting by rust. Either clay type or chemical type of emulsion may be used. These water emulsions should not be permitted to freeze in storage or after application until thoroughly dry.

Asphalt mastics for metal protection consist of petroleum base asphalts, usually blown, and quite often natural asphalt such as gilsonite or wurtzilite. Typical asphalt mastic for weather exposure is covered by SSPC-Paint 12.

Asphalt in the form of a varnish, in which it is cooked with semi-drying or drying oil, is procurable under Federal Specification A-A-1632, "Varnish, Asphalt." This material is covered in SSPC-PS Guide 7.00.

A waterproofing asphalt for hot melt application is covered by ASTM D 449 "Specification for Asphalt Used in Dampproofing and Waterproofing" This material should be applied over an asphalt primer such as listed above. Primer and hot asphalt should be procured from the same source.

**6.8 COAL TAR PAINTING SYSTEMS (NO. 10):** Painting system SSPC-PS 10.01 covers one type of hot-applied coal tar enamel, and SSPC-PS 10.02 covers one type of cold-applied coal tar mastic. They are outlined in Table 4. The properties and uses of these two systems are somewhat different.

**6.8.1 Use:** The hot-applied coal tar system PS 10.01 consists of commercial blast cleaning (or pickling), one prime coat and two finish coats of hot-applied coal tar enamel. This painting system is intended primarily for underwater or underground use. For exposure to sunlight, it requires a topcoat of coal tar emulsion to prevent checking and alligatoring. The painting system has good abrasion resistance and is suitable for pipelines, hydraulic structures, piling, underground tanks, water tank interiors, sheet piling, corrosive interiors, underground or submerged portions of barges and dry docks, aeration and humidifying equipment, ballast tanks and bilges, classifiers, coal washers and culverts. It is, however, dissolved by some organic solvents and attacked by some oxidizing solutions.

The cold-applied coal tar system PS 10.02 is typically applied to barges, dry docks, aeration and dehumidifying equipment, ballast tanks and bilges, piling, classifiers, coal washers, floatation equipment, culverts, dams and flood gates, floats and pontoons.

**6.8.2 Description:** Painting System 10.01 requires a hot-applied primer as specified in AWWA C 203 (synthetic type). It is followed by a coat of coal tar enamel applied, usually in two coats, to a total thickness of 2.4 ± 0.8 mm (3/32 ± 1/32 inch). Where potable water is being used, AWWA C 203 is applicable. Experienced and skilled workmanship is required to apply this system properly.

Painting System No. 10.02, Cold-Applied Coal Tar Mastic, is used for steel structures in corrosive environments. It requires commercial blast cleaning (or pickling) followed by two coats of MIL-C-18480, "Coating Compound, Bituminous, Solvent Coal Tar Base." All areas exposed to sunlight must then be topcoated with a suitable topcoat, such as SSPC-Paint 32.

**6.8.3 Other Specifications and Properties:** The types of coal tar coatings are parallel to those of asphalt coatings, including cutbacks of coal tar pitch in solution, filled or unfilled, and hot-applied enamels (no filler) used over a cutback coal tar primer.

Coal tar coatings have better water resistance than asphalt and are superior to asphalt for a given thickness in underground burial. Coal tars are poorer than asphalt, however, in weather resistance (unless emulsion topcoated) and in acid resistance.

Coal tar paint without filler, which results in comparatively thin, dry films, is covered by the U.S. Bureau of Reclamation Specification CTP-3, "Coal-Tar Paint." Thick film, mastic type coal tar coatings are also available under U.S. Bureau of Reclamation Specification CA-50.

American Water Works Association Specifications C 203 for coal tar primer and coal tar enamels are extensively used. Coal tar pitch may be applied as a hot melt over coal tar primer.

Coal tar paints and field coatings, primer and hot enamel are procurable under MIL-C-18480, "Coating Compound, Bituminous, Solvent, Coal Tar Base."

The most recent SSPC coal tar specifications are SSPC-Paint 32, "Coal-Tar Emulsion Coating," and SSPC-Paint 33, "Coal Tar Mastic, Cold-Applied." Paint 33 is for use underground or underwater and must be topcoated with Paint 32 if it exposed to the atmosphere. Paint 32 is a weather coat and may be applied hot or cold.

**6.9 COAL TAR EPOXY PAINTING SYSTEM (SSPC-PS 11.01)**

**6.9.1 Use:** This SSPC painting system consists of two coats of the specified polyamide coal tar epoxy paint applied to a near-white blast cleaned structural steel surface.

It is used on structural steel in marine or chemical environments, buried tanks and pipes, immersion in fresh

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 4**
**Summary of Painting Systems 9 and 10**
**NO. 9-ASPHALT PAINTING SYSTEMS**
**NO. 10-COAL TAR PAINTING SYSTEMS**

| Code | SSPC-PS 9.01 | SSPC-PS 10.01 | SSPC-PS 10.02 |
|---|---|---|---|
| **Min. Surface Prep.** | SSPC-SP 6, commercial, or SP 8, pickling | SSPC-SP 6, commercial, or SP 8, pickling | SSPC-SP 6, commercial, or SP 8, pickling |
| **Paint Application** | SSPC-PA 1, Shop Field & Maintenance Painting | SSPC-PA 1 and AWWA C 203 | SSPC-PA 1, Shop Field & Maintenance Painting |
| **Number of Coats** | 1 or 2 | 3 (unless otherwise specified) | 2 underground or underwater; 3 where exposed to sunlight |
| **First Coat** | SSPC-Paint 12, Cold-Applied Asphalt Mastic (Extra Thick Film) | Hot-applied coal tar enamel per AWWA C 203 | MIL-C-18480, Coating Compound, Bituminous, Solvent, Coal Tar Base* |
| **Touch-Up** | SSPC-PA 1 | SSPC-PA 1 | SSPC-PA 1 |
| **Second Coat** | None required, unless specified | Same as first coat | Same as first coat |
| **Third Coat** | | Same as first coat | Topcoat all areas exposed to atmosphere and sunlight. See SSPC-Paint 32. |
| **Alternates** | See PS 10.01 and 10.02 | Topcoat all areas exposed to atmosphere and sunlight. See SSPC-Paint 32. | |
| **Minimum Dry Film Thickness (DFT)** | 1600 μm (63 mils) | Primer-13 to 50 μm (0.5 to 2 mils)<br>3 coats-1600 μm (63 mils)<br>4 coats-1830 μm (72 mils) | 2 coats-625 μm (25 mils)<br>3 coats-900 μm (35 mils) |
| **Recommended for** | Severe atmospheric exposure, exteriors of acid tanks, refineries, brine drippings, heavy industrial plants, roofing, siding, etc. (Not in contact with oils or solvents.) | Underwater and underground use. Pipelines, marine and hydraulic structures, piling, underground tanks, water tank interiors. (Not in contact with oils or solvents.) | Underground or underwater, damp areas, abraded areas, marine, hydraulic structures and pipe, corrosive interiors. (Not for potable water or high temperature or contacting solvents.) |
| **Color** | Black | Black | Black |
| **Through dry (max.)** | 36 hours (practical hardness) | One hour applied hot. Can be handled as soon as it cools and hardens. | 24 hours (recoat) |

* See SSPC-Paint 33, "Coal Tar Mastic, Cold-Applied."

or salt water, tidal zone, splash zone, weather zone, and for the interiors of tanks containing crude oil, salt brine, or petroleum products.

**6.9.2 Description:** Coal tar epoxy paint as made by its numerous manufacturers is a material of rather widely varying characteristics with respect to curing, pot life, odor, viscosity, ease of application, and performance.

Coal tar epoxy coatings are heavy bodied, thixotropic materials with a high non-volatile content on the order of 85 percent or more by weight. These characteristics permit heavy applications ranging up to 250 micrometers (10 mils) or more dry film thickness per coat, provided field thinning is held to a minimum. These materials may be brush or spray applied. Spray equipment may be of the conventional air-atomizing type if modified to include a large diameter material hose, a large orifice nozzle, and material pump or bottom withdrawal pot. High pressure airless spray equipment is also being used with good results on flat surfaces. The coal tar epoxy coatings are usually applied without a special primer in two coats to a minimum dry film thickness at any point of 400 micrometers (16 mils) over commercial or near-white blast cleaned surfaces. They should not be applied unless the metal and ambient temperatures at the time of application are above 10°C (50°F) and unless it can be anticipated that an average temperature of 10°C (50°F)

Provided by : www.spic.ir Licensee: NISOC Library

or higher will prevail for several days after application. The curing time between coal tar epoxy coats should not exceed a day or two, particularly in hot weather, if the possibility of poor intercoat adhesion is to be avoided. In maintenance repainting or in repairing damaged areas the attainment of good adhesion between old and new paint may be troublesome unless the undercoat is thoroughly cleaned and roughened by brush-off blast cleaning.

Coal tar epoxy coatings tend to become increasingly hard during the early years of exposure, but there is no indication when applied to steel of moderate and heavy cross-section that they will eventually become critically inflexible. Coal tar epoxy coatings on steel surfaces are capable of providing long term protection in situations involving fresh water immersion, condensation, sea water immersion, tidal and splash zone exposure, burial in the soil, and exposure to brine, salt, crude oil, sewage, and some chemicals. They are considered to be reasonably durable in ordinary weather exposure and may become more so if the final coat of coal tar epoxy is formulated to contain some aluminum pigment or if topcoated with a compatible aluminum paint. Coal tar epoxy coatings, if given plenty of curing time before exposure, are resistant to the erosive action of high velocity water but are not as resistant to gouging by waterborne ice and massive debris as the best of other coatings are. Gouge resistance may be improved by filling or reinforcing with garnet or other sandlike particles in the 30-70 sieve size range.

The only known specification issued by U.S. Federal authorities for coal tar epoxy paint is MIL-P-23236. This specification is intended to obtain suitable coating material for fuel and salt water ballast tanks of ships and is set up on a "Qualified Products List" basis, administered by the U.S. Navy Department.

Coal tar urethane coatings having properties somewhat similar to coal tar epoxy paints are available.

### 6.10 ZINC-RICH PAINTING SYSTEMS (NO. 12)

**6.10.1 Use:** Zinc-rich coatings may be used in a variety of environments, but are mainly intended for use in conditions of high humidity or marine atmosphere exposures, both exterior and interior, and for fresh water immersion. With appropriate topcoating, they may be used for brackish and sea water immersion and for exposure to chemical fumes. Untopcoated inorganic zinc-rich coatings have been used successfully in ballast tanks where they are subjected to salt water immersion.

**6.10.2 Description:** The Guide to Zinc-Rich Coating Systems, SSPC-PS 12.00, is based primarily upon performance. The One-Coat Zinc-Rich Painting System, SSPC-PS 12.01, is based upon SSPC-Paint 20, Zinc-Rich Primers, (Type 1, "Inorganic" and Type II, "Organic"). Zinc-rich coatings are heavily pigmented with metallic zinc to form an electrically conductive coating. Long-term protection is by a barrier mechanism. This is supplemented by galvanic protection from the zinc at scratches or breaks in the paint film. Zinc corrosion products formed in providing this protection tend to block small breaks in the coating to sustain barrier protection. To obtain such galvanic action from coatings based on organic vehicles, it is necessary to have a higher percentage of zinc in the dry film. SSPC-Paint 29, "Zinc Dust Sacrificial Primer, Performance Based" with a somewhat reduced level of zinc may also be used.

The vehicle composition of zinc-rich paints described in SSPC-Paints 20 and 29 may be either organic or inorganic. Depending upon the skill of formulation, good results have been obtained with a wide variety of vehicles including inorganics such as zinc silicates and phosphates, and organics such as epoxies, chlorinated rubber, and polyesters.

Some properties depend on the type of vehicle. However, zinc-filled coatings are unsuitable for acid service without suitable topcoats and their alkali resistance is also very limited. The inorganic coatings have outstanding ability to withstand exposure to solvent, oils, and petroleum products. They are also unaffected by aliphatics, aromatics, ketones or alcohols. They resist dry chlorinated hydrocarbons, but are attacked by wet chlorinated solvents that release hydrochloric acid. They are very resistant to high humidity, splash, and spray, but most types should be sealed or topcoated for continuous salt water exposure. For high temperature service, the recommended maximum is 60°C (140°F) wet, or 370°C (700°F) dry. Abrasion and impact resistance, as well as oil resistance, have proved excellent in SSPC tests. Weathering of the inorganic zinc-filled coatings is considered excellent, as the coatings continue to cure during prolonged exposure.

Inorganic zinc-rich coatings are available in one-, two-, and three-package forms. The two-package materials are called self-curing and consist of zinc dust mixed with the inorganic vehicle just before application. With some coatings commercial grade blast cleaning is considered satisfactory, while others require near-white metal blast cleaning. The three-package, or post-cured, material consists of zinc dust stirred into the inorganic vehicle shortly before application. This coating is then very vulnerable to rain or other water until the curing solution (usually acid-based) is applied. Near-white blast cleaning is considered the minimum surface preparation. The resulting surface of both self-curing and post-curing types has no gloss and is similar in appearance to weathered galvanized steel.

Organic zinc-rich coatings are also available in one-, two-, and three-package forms. The three-package material consists of zinc dust, resin component, and curing agent, which are mixed and applied to a thickness of 50 to 100 micrometers (2 to 4 mils). This coating is then somewhat vulnerable to rain until the solvents have essentially evaporated. The resulting surface has no gloss and re-

Provided by : www.spic.ir Licensee: NISOC Library

sembles weathered galvanized steel. Two-package is the same as three-package except that the zinc is incorporated into one of the two parts of the vehicle and the remaining part is added before application. One-package is completely mixed in one container and ready to use. Many of the organic zinc-rich formulations have rapid air-drying rates. Others are cured by baking. Near-white blast cleaning is considered advantageous, although many organic zinc-rich coatings have adequate adhesion on clean, dry mill scale surfaces.

### 6.11 EPOXY PAINTING SYSTEM (SSPC-PS 13.01)

**6.11.1 Use:** Epoxy-Polyamide Painting System, SSPC-PS 13.01, consists of application of a polyamide epoxy primer, intermediate and finish coat (SSPC-Paint 22) to commercially blast cleaned steel. The required SSPC paint specifications are based upon performance tests of primer and topcoats formulated within specified composition limits. The system is designed for industrial exposure, marine environment, areas subject to chemical exposures, and areas frequently wet by fresh and salt water.

SSPC-PS 13.01 is based upon three coats of polyamide catalyzed epoxy paint (SSPC-Paint 22) whose specifications are comprised of a combination of performance and composition requirements. The stipulations for interval between coats are believed to be important in order to achieve good intercoat adhesion. For this reason, it is not recommended that the primer be applied in the shop and the remainder applied during construction.

**6.11.2 Description:** The epoxies are a versatile family of resins having good flexibility, hardness, toughness, adhesion, and high solids. The air-drying epoxies may be divided for convenience into four principal classes: (1) epoxy esters, (2) amine catalyzed, (3) amine adducts and (4) polyamide catalyzed.

The epoxy ester is obtained by modifying the resin with a vegetable oil fatty acid. These paints require no catalyst, and are considered competitive for general plant maintenance with the other oil-modified paint systems such as alkyds, with good color retention, ease of application, some chemical resistance, but poor gloss retention. With properly formulated epoxy esters, thorough hand tool cleaning (SSPC-SP 2) may be used as a surface preparation in shop or maintenance painting of steel that is not heavily rusted. Commercial or near-white blast cleaning is recommended for the amine or polyamide catalyzed epoxy.

The amine catalyzed epoxy involves the addition of a catalyst or activator just prior to use, thereby permitting the application of a fairly thick, very adherent film that dries through fairly rapidly at 15°C (60°F) or above. It has excellent resistance to chemicals, to non-oxidizing acids, brine solutions, certain organic products, and heat.

Epoxy formulations using the polyamide type of curing agent exhibit less overall chemical resistance but better water resistance, color retention, and flexibility when compared with either the amine or amine adduct curing agent. They also have a better catalyst ratio, are considered nontoxic and less affected by poor surface preparation, handling, and application. Epoxies can be applied in single coats 250 to 380 micrometers (10 to15 mils) thick, but coats of more conventional thickness are used to avoid shrinkage, solvent entrapment, cracks, and loss of adhesion. Two-part epoxy coatings have also been formulated in water-thinned systems. A water-borne epoxy primer for steel is described in SSPC-Paint 28.

**6.12 STEEL JOIST SHOP PAINTING SYSTEM (SSPC-PS 14.01):** This paint is intended as a one-coat shop paint for open web and long span steel joists that may be either enclosed or exposed in the interiors of buildings where the temperature rarely falls below the dew point, where the relative humidity rarely exceeds 85 percent, and where corrosive protection is not necessary.

### 6.13 CHLORINATED RUBBER PAINTING SYSTEMS (NO. 15)

**6.13.1 Use:** Chlorinated rubber coatings are quick-drying heavy-duty coatings with excellent chemical resistance to acids, alkalis, and water. Their use in maintenance and marine coating systems is widespread because they can be applied over wide ranges of temperature and humidity which allows application work to continue winter and summer.

**6.13.2 Description:** In the chlorination process, isoprene reacts with chlorine to yield a product having 63 to 67 weight percent chlorine. In this polymer all double bonds are saturated with chlorine providing the material with optimum compatibility, stability, and fire resistance.

Chlorinated rubber is a tough film former. Ordinarily it is plasticized to become more flexible and adherent to steel. Formulations based on chlorinated rubber and chlorinated modifiers have been developed to provide systems with superior resistance to acids, alkalis, salt solutions, fresh water, and sea water. Generally, chemical resistance improves at low plasticizer levels. These coating systems are not resistant to aromatic or oxygenated solvents and to temperatures above 70°C (160°F).

A guide for selecting chlorinated rubber painting systems is described in SSPC-PS Guide 15.00. Typical formulas are described in SSPC-Paints 17, 18, and 19. The paints are applied as three-coat systems with the primer usually applied immediately after blast cleaning. Based on solvent selection, it is possible to apply three coats within 24 hours. Recoatability is never a problem when aged paint is free of oil, dirt, and chalk, since newly applied coats interact with aged chlorinated rubber films and form a monolithic film.

Provided by : www.spic.ir Licensee: NISOC Library

When using chlorinated rubber coatings, a wide range of solvent selection is available. Chlorinated rubber is readily soluble in most classes of solvents. Exceptions are alcohols, aliphatic hydrocarbons, and water. Care is necessary in selecting the proper solvent blend to meet variables such as weather conditions or type of application (conventional or airless spray, brush or roller) and government restrictions.

### 6.14 SILICONE-ALKYD PAINTING SYSTEM (SSPC-PS 16.01)

**6.14.1 Use:** The silicone alkyd painting system is used for new structural steel surfaces in industrial, rural, or marine atmospheres. This painting system can replace alkyd painting systems, with the advantage of superior exterior weatherability and minimum film erosion as shown by chalk resistance, gloss retention, and color retention. The painting system is acceptable for steel surfaces that will be exposed to the weather, high humidity, infrequent immersion, mild chemical atmospheres, and high temperature.

**6.14.2 Description:** The silicone alkyd painting system consists of three coats. The primer and intermediate coat are used with available organic paint systems. The finish coat is the silicone alkyd paint (SSPC-Paint 21), either high gloss (Type I) or medium gloss (Type II). The high gloss paint is similar to Federal Specification TT-E-1593. A range of colors is available.

Silicone modification of the alkyd resin significantly improves its overall weatherability. The inertness of silicones, coupled with their moisture resistance, produces air-drying silicone alkyd copolymer resins which provide excellent durability because of their resistance to chalking which limits the rate at which film erosion takes place.

Extended tests on paint panels exposed in Florida at 45° south have shown that coatings containing 25 to 30 percent silicone intermediate resist chalking for up to three years. Non-silicone coatings weathered along with the silicone alkyd copolymer coatings chalked rapidly in comparison.

The advantages of coating systems that resist chalking are obvious. First, colored finishes will retain their initial appearance for a longer period of time and will not appear washed out and faded. Secondly, as previously mentioned, nonchalking finishes retain initial film thickness longer. Since a specific thickness of film protects the substrate, a coating that retains its film integrity will protect against corrosion for a longer period of time.

Silicone alkyd copolymer resins have the same general physical properties as conventional alkyd resins. Coatings can be applied in the usual manner by either brushing or spraying and require no unusual surface preparation. The same types of primers used for conventional alkyds should be used for silicone alkyds, since the main function of the silicone content is to provide final-coat protection from direct weathering.

The current applications of silicone modified alkyd paints include outdoor storage tanks, ships, chemical process equipment, buildings, bridges, and many other steel structures where improved film life and exterior weatherability are required.

### 6.15 URETHANE PAINTING SYSTEMS (SSPC-PS GUIDE 17.00)

**6.15.1 Use:** Both uses and costs vary widely. Urethane coatings are currently being used successfully for maintenance of chemical plants, tankers, storage tanks, ships, and as exterior architectural varnishes.

**6.15.2 Description:** Coatings made from isocyanates are sometimes known as polyurethanes or urethanes. They are formed by reaction between an isocyanate (RNCO) and a hydroxy compound (ROH) to form a urethane (RNHCOOR). If polyfunctional compounds are used, useful polyurethanes are formed, and some of these find applications as surface coatings.

The properties of this class of materials can be varied more widely than almost any other general class of polymer, since the hydroxy-containing reactant may be a drying oil, a non-drying oil, or a resin of the polyester, polyether, polyamine, polyamide, polyol, or other type. There are also several types of polyisocyanate that can be reacted. The resulting properties of the coating may range from fast to slow curing, from hard to flexible to soft types, and from extremely chemical resistant to low chemical resistant types.

Single package urethane coatings are made by reacting the isocyanate group with a drying oil. This results in the familiar type of drying oil coating that contains a metallic soap drier and dries by oxidation of the drying oil. The oil-modified urethane oils have been considered similar to alkyd resins, but with faster drying time and better resistance to water, humidity, and abrasion.

Pre-polymer types of single package coating result when the isocyanate groups are partially pre-reacted. When the coating is applied, these products then harden by reaction of these groups with atmospheric moisture. A catalyst can also be reacted with this type to accelerate the cure at room temperature. Many variations are possible, but two-package pre-polymers usually have limited pot life after mixing, and the catalyst ratio must be closely controlled.

Pre-polymers based on castor oil have better general durability than the drying oil modified urethanes, but do not have the chemical and solvent resistance of the two-package catalyzed materials. Specific resistance properties, however, can be tailored by proper choice of composition.

Provided by : www.spic.ir Licensee: NISOC Library

In general, abrasion resistance, hardness, and impact resistance of the urethanes are outstanding. They are less sensitive than most coatings to high humidity during application, but the single-package pre-polymers, which cure by reaction with moisture, are retarded at relative humidities below 30 percent. Adhesion is good but special primers may be necessary for water immersion. For the catalyzed types, surface preparation by blast cleaning to white metal is usually recommended for applications to structural steel.

**6.16 LATEX PAINTING SYSTEMS (SSPC-PS 18.01 AND SSPC-PS 24.00)**

**6.16.1 Use:** Latex painting systems are suitable for all zones except immersion and extreme chemical exposures. Painting system SSPC-PS 18.01 describes a latex system suitable for use on normally dry interior and exterior exposures, as well as high humidity or mild chemical atmospheres. Painting system SSPC-PS 24.00, however, is also applicable to industrial and marine exposures.

**6.16.2 Description:** Painting system SSPC-PS 18.01 requires commercial blast cleaning (SSPC-SP 6) or pickling (SSPC-SP 8). Some procurement documents may specify a better degree of cleaning such as SSPC-SP 5, "White Metal Blast Cleaning" or SSPC-SP 10, "Near-White Blast Cleaning." The three-coat painting system consists of SSPC-Paint 23, "Latex Primer for Steel Surfaces," an intermediate coat (Paint 23 tinted for color contrast), and the finish coat of SSPC-Paint 24, "Latex, Semi-Gloss Exterior Topcoat." The finish paint is semi-gloss, chalk resistant and allows for a choice of colors.

Unlike most other SSPC painting systems, SSPC-PS 24.00 is performance-based; that is, the system must pass a battery of laboratory and field tests. Three levels of performance are described. The first level is based on early rusting, salt fog resistance, and other laboratory tests. The second and third levels require test fence evaluations of 12 months and 36 months, respectively, in addition to the laboratory testing. The paints in this system must have maximum VOC content of 340 g/liter.

**6.17 PAINTING SYSTEMS FOR SHIPS (NO. 19 THROUGH 22):** These painting systems are intended primarily for steel vessels and floating structures exposed to fresh water or salt water, fouling waters, and the weather. These systems are also suitable for steel in marine installations or for hydraulic structures. Because of the deleterious galvanic action of mill scale in marine exposures, blast cleaning of the steel is the minimum recommended surface preparation for hull exteriors in new work. In maintenance painting, where only small areas need to be cleaned, thorough hand or power tool cleaning may suffice.

The definitions of the ship areas are as follows: The bottom of the steel exterior extends to the light load line. The boottopping is the exterior of the hull from the light load line to the deep load line. The topside is the area above the deep load line exposed to weather. This includes the freeboard (DLL-Rail), weather decks, and superstructure.

**6.18 THERMAL SPRAY METALLIC COATING SYSTEMS [SSPC-CS 23.00(I)]**

**6.18.1 Use:** SSPC-CS 23.00(I), "Interim Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel," was developed jointly by SSPC, the American Welding Society (AWS), and NACE International. It is published by SSPC as an interim specification while awaiting final approval from the other two organizations.

Coating systems consisting of thermally sprayed zinc, aluminum, or zinc/aluminum alloys are suitable for use on structures or parts thereof exposed in SSPC environmental zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water), and 2C (fresh water immersion). With proper sealing/topcoating, thermal spray coatings can also be used in zones 2B (frequently wet by salt water), 2D (salt water immersion), 3A (chemical, acidic), 3B (chemical, neutral), and 3C (chemical, alkaline).

**6.18.2 Description:** Thermal spraying is a process wherein finely divided metallic materials are deposited in a molten or semimolten condition to form a coating. The most common metals used in thermal spraying are zinc, aluminum, or 85%/15% zinc/aluminum alloy.

Surfaces to be sprayed should normally be blast cleaned to white metal (SSPC-SP 5) but in some cases near-white blast cleaning (SSPC-SP 10) is permissible. The abrasive used in the cleaning should produce a sharp angular surface profile. Shot or other abrasives producing a rounded surface profile are not recommended.

Typically, the metal coating is applied at a minimum of 150 micrometers (6 mils) for zinc and zinc alloys and at 100 micrometers (4 mils) for aluminum. Maximum thicknesses are 250 to 380 micrometers (10 to 15 mils). Under some exposure conditions the coating should be sealed or sealed and topcoated.

**6.19 ALUMINUM EPOXY COATING SYSTEM, PERFORMANCE BASED (SSPC-PS 26.00):** This is a coating material specification that sets performance parameters that the coating system must meet. Unlike many other SSPC paint system specifications, PS 26.00 only describes the coating material. To be incorporated into a job specification, other parameters such as surface preparation and paint application must also be specified.

**6.19.1 Use:** Coating systems meeting this specification are suitable for exposures in environmental zones 1A

Provided by : www.spic.ir Licensee: NISOC Library

(interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water, excluding immersion), 2B (frequently wet by salt water, excluding immersion), and 3B (chemical exposure, neutral).

**6.19.2 Description:** This specification covers the requirements for an ambient temperature cure, two-component aluminum pigmented epoxy coating that is intended for use as a single or multi- coat system on steel. The specified coating system is intended for application by brush, spray, or roller. Type I is for use over steel surfaces blast cleaned to SSPC-SP 6 or better. Type II is for use over non-blast cleaned as well as blast cleaned steel surfaces, i.e., surfaces cleaned to SSPC-SP 2 or better.

This coating is typically based on a reactive oxirane (epoxy) functional resin with an amine or polyamide functional curing agent. The principal functional pigment is aluminum paste or flake powder.

**6.20 ALKYD COATING SYSTEM, PERFORMANCE BASED (SSPC-PS 27.00):** This is a coating material specification that sets performance parameters that the coating system must meet. Unlike many other SSPC paint system specifications, PS 26.00 only describes the coating material. To be incorporated into a job specification, other parameters such as surface preparation and paint application must also be specified.

**6.20.1 Uses:** The coating system is suitable for exposure in Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water, excluding immersion), 2B (frequently wet by salt water, excluding immersion).

**6.20.2 Description:** This specification covers the requirements for an air-drying solvent-based alkyd coating system consisting of two or more coats of alkyd intended for use over blast cleaned steel. The specification covers both the system and the individual coating requirements. This multi-coat alkyd coating system specification does not cover coating systems comprised of water-reducible alkyds.

The requirements are based primarily on the performance of the coating system. The coating system is classified as Type 1 (fast drying), Type 2 (medium drying), or Type 3 (slow drying). The coating system is classified according to the drying time (fast, medium, slow) of the slowest drying coating layer.

The finish coat is designated as flat, semigloss, or gloss.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS Guide 1.00
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM GUIDE NO. 1.00

## Guide for Selecting Oil Base Painting Systems

Most needs for oil base painting systems can be met by the standard SSPC Painting Systems 1.04 and 1.09 through 1.13 in this section. Other combinations of surface preparation, primers, intermediates, and topcoats may be selected for special situations for oil painting systems using the following Guide. To do so, select the desired surface preparation, primer, intermediate(s), and topcoat from those listed and insert them into the standard SSPC Painting System format. In order to aid in the selection, short comments are given. For additional information consult the "Commentary on Painting Systems" and the referenced standards.

### 1. Scope

**1.1** These specifications cover oil base painting systems for steel cleaned with hand or power tools.

**1.2** These systems are suitable for use on parts or structures exposed in Environmental Zone 1A (interior, normally dry) and Zone 1B (exterior, normally dry).

**1.3** The oil base primers are slow in drying, but provide the wetting ability necessary for adhesion to nondescaled steel.

**1.4** The color of the finish paint must be specified.

### 2. Description

**2.1** This guide outlines the components of a complete oil base painting system. A painting system shall consist of surface preparation by solvent cleaning and hand or power tool cleaning; one coat of oil base primer; one or two intermediate coat(s); and one finish coat.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 through 3.7 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting System |
| **Paint 11*** | Red Iron, Zinc Chromate, Raw Linseed Oil and Alkyd Primer |
| **Paint 21** | White or Colored Silicone Alkyd Paint |
| **Paint 25** | Red Iron Oxide, Zinc Oxide, Raw Linseed Oil, and Alkyd Primer |
| **Paint 101** | Aluminum Alkyd Paint |
| **Paint 102** | Black Alkyd Paint |
| **Paint 103** | Black Phenolic Paint |
| **Paint 104** | White or Tinted Alkyd Paint |
| **Paint 108** | High-Build Thixotropic Leafing Aluminum Paint |
| **PS 1.04** | Three-Coat Oil-Alkyd (Lead- and Chromate-Free) Painting System for Galvanized or Non-Galvanized Steel (With Zinc Dust-Zinc Oxide Linseed Oil Primer) |
| **PS 1.09** | Three-Coat Oil Base Zinc Oxide Painting System (Without Lead or Chromate Pigment) |
| **PS 1.10** | Four-Coat Oil Base Zinc Oxide Painting System (Without Lead or Chromate Pigment) |
| **PS 1.12** | Three-Coat Oil Base Zinc Chromate Painting System |
| **PS 1.13** | One-Coat Oil Base Slow Drying Maintenance Painting System (Without Lead or Chromate Pigment) |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |
| **SP 11** | Power Tool Cleaning to Bare Metal |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **SP 12/NACE No. 5** | Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating |
| **SP 13/NACE No. 6** | Surface Preparation of Concrete |
| **SP 14/NACE No. 8** | Industrial Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL STANDARDS:**

| | |
|---|---|
| **TT-E-489** | Enamel, Alkyd, Gloss (for Exterior or Interior Surfaces) |
| **TT-E-527** | Enamel, Alkyd, Lusterless |
| **TT-E-529** | Enamel, Alkyd, Semi-Gloss |

**3.7 AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO):**

| | |
|---|---|
| **M 69** | Aluminum Paint |

## 4. Surface Preparation

**4.1 SSPC-SP 2,** "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning":

COMMENT: Blast cleaning (SSPC-SP 5, SP 6, SP 7, SP 10, SP 14) or pickling (SSPC-SP 8) or water jetting (SSPC-SP 12) may be substituted. However, for economy, hand or power tool cleaning is generally used with the primers in this painting system guide. The primers have good to excellent wetting ability and do not require removal of all tight rust and tight mill scale if used in normal or mild atmospheric exposure. However, blast cleaning and pickling surface preparation methods are considered more thorough, and the better cleaning they provide may be more economical or may be required for moderately corrosive conditions. They are therefore very satisfactory alternatives unless warping, safety, or other special considerations make them impractical in particular cases.

## 5. Paints

**5.1 OIL BASE PRIMERS:** After cleaning, the steel shall be primed with one coat of paint conforming with one of the following specifications.

**5.1.1 Proprietary Primer:**

COMMENT: A proprietary primer of proven performance capability should be chosen. Specify the manufacturer, trade name, and product number of the desired proprietary paint. The paint manufacturer should furnish a typical label analysis.

**5.2 OIL/ALKYD PRIMERS:** Alternately the steel shall be primed with one of the following primers.

COMMENT: These primers contain some alkyd resin in addition to their linseed oil content, and may require a more thorough cleaning, as a minimum surface preparation, than straight oil base primers.

**5.2.1 SSPC-Paint 11***, "Red Iron Oxide, Zinc Chromate, Raw Linseed Oil and Alkyd Primer":

**5.2.2 SSPC-Paint 25,** "Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer":

COMMENT: SSPC-Paint 25 is an iron oxide, zinc oxide primer similar in composition to SSPCPaint 11 except that zinc chromate is replaced with zinc oxide.

**5.3 INTERMEDIATE COAT(S) FOR OIL BASE PAINTING SYSTEMS:** The intermediate coat(s) of paint shall conform with one of the following specifications. Also, the intermediate coat(s) of paint may be the same as the prime coat, but shall be tinted with carbon black or lampblack paste in oil, or may instead be the same as the finish coat but tinted to contrast with the finish coat. If an aluminum finish coat is used, the next to last (intermediate) coat may be the same as the last (finish) coat except that the corresponding non-leafing aluminum pigment shall be used in place of leafing aluminum.

**5.3.1 SSPC-Paint 101,** "Aluminum Alkyd Paint," Type II, "Non-Leafing":

COMMENT: This non-leafing aluminum paint is suitable for use as an intermediate coat where the final paint coat is to be a leafing aluminum paint and where longer weathering without the prime coat showing through the aluminum finish coat is desired.

**5.3.2 Proprietary Intermediate:**

COMMENT: A proprietary intermediate of proved performance capability may be substituted for the above if desired by the specifier. Specify the manufacturer, trade name, and product number of the desired proprietary paint. The paint manufacturer should furnish a typical label analysis.

**5.4 ALUMINUM FINISH COATS:** The paint shall conform with one of the following specifications.

**5.4.1 SSPC-Paint 101,** "Aluminum Alkyd Paint," Type I, "Leafing":

COMMENT: This aluminum alkyd paint has good stability, drying, and application properties as well as excellent durability in atmospheric exposures. Its lapping properties are fairly good. It is generally mixed on the job by adding two

Provided by : www.spic.ir Licensee: NISOC Library

pounds of aluminum paste to one gallon of alkyd varnish vehicle.

**5.4.2 SSPC-Paint 108,** "High Build Thixotropic Leafing Aluminum Paint":

COMMENT: Added protection is possible because of the thicker film which may be applied with this special high build composition.

**5.4.3 AASHTO Specification,** "Aluminum Paint," Designation M 69:

COMMENT: AASHTO ready to mix aluminum finish coat for bridges, having an oleoresinous tung oil spar varnish vehicle.

**5.5 BLACK FINISH COATS:** The paint shall conform with one of the following specifications.

**5.5.1 SSPC-Paint 102,** "Black Alkyd Paint":

COMMENT: A very durable carbon black and long oil alkyd varnish paint which is recommended for severe exposures such as railroad bridges and industrial atmospheres.

**5.5.2 SSPC-Paint 103,** "Black Phenolic Paint":

COMMENT: A carbon black and silica phenolic varnish paint which is suitable for water immersion, high humidity, condensation, industrial atmospheres, or chemical environments.

**5.6 WHITE OR TINTED FINISH COATS:** If a colored finish coat is specified, the type and shade should be agreed upon between the parties concerned, using a suitable method of color designation. The paint shall conform with one of the following specifications.

**5.6.1 SSPC-Paint 104,** "White or Tinted Alkyd Paint":

COMMENT: A long oil alkyd paint that has good stability, drying, and application properties as well as excellent durability in atmospheric exposures. It has good resistance to atmospheric exposure, particularly industrial atmospheres.

**5.6.2 Federal Specification TT-E-489 Class A,** "Enamel Alkyd, Gloss (for Exterior or Interior Surfaces)":

COMMENT: A series of medium oil, alkyd colored enamels, suitable for interior or exterior use; high gloss but low build per coat; particularly suited for machinery and similar equipment where appearance is important.

**5.6.3 Federal Specification TT-E-529 Class A,** "Enamel, Alkyd, Semi Gloss":

COMMENT: Similar to preceding, but semi-gloss.

**5.6.4 Federal Specification TT-E-527,** "Enamel, Alkyd, Lusterless":

COMMENT: Similar to preceding two paints, but flat finish.

**5.6.5 SSPC-Paint 21,** "White or Colored Silicone Alkyd Paint," Type I, "High Gloss" or Type II, "Medium Gloss":

COMMENT: Silicone alkyd paints are highly weather resistant and are characterized by excellent color and gloss retention. Twelve colors are described under each type.

**5.7 PROPRIETARY FINISH:**

COMMENT: A proprietary finish of proved performance capability may be substituted for any of the above if desired by the specifier. Specify the manufacturer, trade name, color, and product number of the desired proprietary paint. The paint manufacturer should furnish a typical label analysis.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow the requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting".

COMMENT: When short oil alkyd or phenolic finish coats or intermediate coats are used over oil base paints, at least one week drying time should be allowed for the oil base paint.

**6.2 FIELD TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting" and in particular with section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** The provisions of SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," should be followed.

COMMENT: This guide covers the steps necessary for repaint previously painted steel surfaces.

**6.4 NUMBER OF COATS**: A minimum of three.

COMMENT: Three coats are required for usual conditions. Two coats will result in an uneconomically thin paint film and shorter life in normal atmospheric exposures. Four coats are recommended in more severe exposures such as near the seashore and areas of high humidity.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 50 micrometers (2.0 mils); for a three-coat system 115 micrometers (4.5 mils); for a four-coat painting system 150 micrometers (6.0 mils).

## 7. Inspection

**7.1** All work and materials supplied under this specification is 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

Provided by : www.spic.ir Licensee: NISOC Library

this specification. In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

**7.4** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

* This paint contains chromate pigments. Users are urged to follow all health, safety, and environmental requirements in applying, handling or disposing of these materials.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 1.09
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 1.09

## Three-Coat Oil Base Zinc Oxide Painting System (Without Lead or Chromate Pigment)

### 1. Scope

**1.1** This specification covers an oil base, lead- and chromate-free painting system for steel cleaned with hand or power tools.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zone 1A (interior, normally dry) and Zone 1 B (exterior, normally dry).

**1.3** The finish paint allows for a choice of durable, fade-resistant colors.

### 2. Description

**2.1** This painting system consists of surface preparation by solvent cleaning and hand or power tool cleaning, one coat of zinc oxide linseed oil/alkyd primer, and two coats of alkyd white or tinted finish coat.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 25** | Red Iron Oxide, Zinc Oxide, Raw Linseed Oil, and Alkyd Primer |
| **Paint 101** | Aluminum Alkyd Paint |
| **Paint 104** | White or Tinted Alkyd Paint |
| **Paint 108** | High-Build Thixotropic Leafing Aluminum Paint |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1** SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning." If specified in the procurement documents, blast cleaning or pickling shall be substituted (SSPC-SP 5, 6, 7, 8, or 10).

### 5. Paints

**5.1 PRIMER:** SSPC-Paint 25, "Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer."

**5.2 INTERMEDIATE (SECOND COAT):** SSPC-Paint 104, "White or Tinted Alkyd Paint," tinted with carbon black or lampblack dispersion to a color contrasting with that of the finish paint.

**5.3 FINISH COAT:** SSPC-Paint 104, "White or Tinted Alkyd Paint." The color must be specified.

**5.4 ALTERNATIVE FINISH COAT:** If specified in the procurement documents, a finish coat complying with specification SSPC-Paint 101, "Aluminum Alkyd Paint, Leafing (Type I)," shall be applied in place of the standard finish coat. If this alternative finish coat is used, then the intermediate coat shall consist of one coat of SSPC-Paint 101, "Alkyd Aluminum Paint, Non-Leafing (Type II)."

**5.5 ALTERNATIVE FINISH COAT:** If specified in the procurement documents, a finish coat complying with specification SSPC-Paint 108, "High-Build Thixotropic Leafing Aluminum Paint," shall be applied in place of the standard finish coat. If this alternative finish coat is used, then no

Provided by : www.spic.ir Licensee: NISOC Library

intermediate coat shall be required, but the dry film thickness shall not be less than 50 micrometers (2.0 mils) for the finish coat and 114 micrometers (4.5 mils) for the painting system.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and in particular with the section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** The provisions of SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," should be followed.

**6.4 NUMBER OF COATS:** Minimum of three.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 50 micrometers (2.0 mils); intermediate coat 38 micrometers (1.5 mils); finish coat 25 micrometers (1.0 mil); for the three-coat painting system 114 micrometers (4.5 mils). If an alternative finish coat is used as indicated in Section 5.5, see that section for dry film thickness requirements.

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 1.10
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 1.10

## Four-Coat Oil Base Zinc Oxide Painting System (Without Lead or Chromate Pigment)

### 1. Scope

**1.1** This specification covers an oil base, lead- and chromate-free painting system for steel cleaned with hand or power tools.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zone 1A (interior, normally dry) and Zone 1 B (exterior, normally dry).

**1.3** The finish paint allows for a choice of durable, fade-resistant colors.

### 2. Description

**2.1** This painting system consists of surface preparation by solvent cleaning and hand or power tool cleaning, two coats of zinc oxide linseed oil/alkyd primer, and two coats of alkyd white or tinted finish coat.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 25** | Red Iron Oxide, Zinc Oxide, Raw Linseed Oil, and Alkyd Primer |
| **Paint 101** | Aluminum Alkyd Paint |
| **Paint 104** | White or Tinted Alkyd Paint |
| **Paint 108** | High-Build Thixotropic Leafing Aluminum Paint |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1** SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning." If specified in the procurement documents, blast cleaning or pickling shall be substituted (SSPC-SP 5, 6, 7, 8, or 10).

### 5. Paints

**5.1 PRIMER:** SSPC-Paint 25, "Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer."

**5.2 SECOND COAT:** SSPC-Paint 25, "Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer" tinted with carbon black or lampblack dispersion to a color contrasting with that of the primer.

**5.3 THIRD COAT:** SSPC-Paint 104, "White or Tinted Alkyd Paint," tinted with carbon black or lampblack dispersion to a color contrasting with that of the finish paint.

**5.4 FINISH COAT:** SSPC-Paint 104, "White or Tinted Alkyd Paint." The color must be specified.

**5.5 ALTERNATIVE FINISH COAT:** If specified in the procurement documents, a finish coat complying with specification SSPC-Paint 101, "Aluminum Alkyd Paint, Leafing (Type I)," shall be applied in place of the standard finish coat. If this alternative finish coat is used, then the intermediate coat shall consist of one coat of SSPC-Paint 101, "Alkyd Aluminum Paint, Non-Leafing (Type II)."

Provided by : www.spic.ir Licensee: NISOC Library

**5.6 ALTERNATIVE FINISH COAT:** If specified in the procurement documents, a finish coat complying with specification SSPC-Paint 108, "High-Build Thixotropic Leafing Aluminum Paint," shall be applied in place of the standard finish coat. If this alternative finish coat is used, then no third coat shall be required, but the dry film thickness shall not be less than 64 micrometers (2.5 mils) for the finish coat and 150 micrometers (6.0 mils) for the painting system.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel" and in particular with the Section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** The provisions of SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems" should be followed.

**6.4 NUMBER OF COATS:** Minimum of four.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 50 micrometers (2.0 mils); for the four coat painting system 150 micrometers (6.0 mils). If alternative finish coat is used as indicated in Section 5.6, see that section for dry film thickness requirements.

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 1.12
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 1.12

## Three-Coat Oil Base Zinc Chromate Painting System

### 1. Scope

**1.1** This specification covers an oil base, zinc chromate painting system for steel cleaned with hand or power tools.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zone 1A (interior, normally dry) and Zone 1B (exterior, normally dry).

**1.3** The finish paint allows for a choice of durable, fade-resistant colors.

### 2. Description

**2.1** This painting system consists of surface preparation by solvent cleaning and hand or power tool cleaning, one coat of zinc chromate linseed oil/alkyd primer, and two coats of alkyd white or tinted finish coat.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 11*** | Red Iron, Zinc Chromate, Raw Linseed Oil and Alkyd Primer |
| **Paint 101** | Aluminum Alkyd Paint |
| **Paint 104** | White or Tinted Alkyd Paint |
| **Paint 108** | High-Build Thixotropic Leafing Aluminum Paint |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1** SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning." If specified in the procurement documents, blast cleaning or pickling shall be substituted (SSPC-SP 5, 6, 7, 8, or 10).

### 5. Paints

**5.1 PRIMER:** SSPC-Paint 11*, "Red Iron Oxide, Zinc Chromate, Raw Linseed Oil and Alkyd Primer."

**5.2 INTERMEDIATE (SECOND COAT):** SSPC-Paint 104, "White or Tinted Alkyd Paint," tinted with carbon black or lampblack dispersion to a color contrasting with that of the finish paint.

**5.3 FINISH COAT:** SSPC-Paint 104, "White or Tinted Alkyd Paint." The color must be specified.

**5.4 ALTERNATIVE FINISH COAT:** If specified in the procurement documents, a finish coat complying with specification SSPC-Paint 101, "Aluminum Alkyd Paint, Leafing (Type I)," shall be applied in place of the standard finish coat. If this alternative finish coat is used, then the intermediate coat shall consist of one coat of SSPC-Paint 101, "Alkyd Aluminum Paint, Non-Leafing (Type II)."

**5.5 ALTERNATIVE FINISH COAT:** If specified in the procurement documents, a finish coat complying with specification SSPC-Paint 108, "High-Build Thixotropic Leafing Aluminum Paint" shall be applied in place of the standard finish coat. If this alternative finish coat is used, then no intermediate coat shall be required, but the dry film thick-

Provided by : www.spic.ir Licensee: NISOC Library

ness shall not be less than 64 micrometers (2.5 mils) for the finish coat and 114 micrometers (4.5 mils) for the painting system.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel" and in particular with the section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** The provisions of SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems" should be followed.

**6.4 NUMBER OF COATS:** Minimum of three.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 50 micrometers (2.0 mils); intermediate coat 38 micrometers (1.5 mils); finish coat 25 micrometers (1.0 mil); for the three-coat painting system 114 micrometers (4.5 mils). If an alternative finish coat is used as indicated in Section 5.5, see that section for dry film thickness requirements.

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

* This paint contains chromate pigments. Users are urged to follow all health, safety, and environmental requirements in applying, handling or disposing of these materials.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 1.13
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 1.13

## One-Coat Oil Base Slow Drying Maintenance Painting System (Without Lead or Chromate Pigments)

### 1. Scope

**1.1** This specification covers a one-coat oil base, lead- and chromate-free painting system for steel cleaned with hand or power tools.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zone 1A (interior, normally dry) and Zone 1B (exterior, normally dry).

**1.3** This system is never used as a shop coat because of its very long drying time. It is unsuitable for use where the slow drying, slippery paint film would be dangerous to workmen when walking or climbing on painted surfaces.

### 2. Description

**2.1** This painting system consists of surface preparation by solvent cleaning and hand or power tool cleaning and one coat of slow drying linseed oil maintenance primer.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 26** | Slow-Drying Linseed Oil Black Maintenance Primer (Without Lead and Chromate Pigments) |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1** SSPC-SP 2, "Hand Tool Cleaning", or SSPC-SP 3, "Power Tool Cleaning." If specified in the procurement documents, blast cleaning or pickling shall be substituted (SSPC-SP 5, 6, 7, 8, or 10).

### 5. Paints

**5.1 PRIMER:** SSPC-Paint 26, "Slow Drying Linseed Oil Maintenance Primer."

### 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and in particular with the section thereof entitled "Field Painting of Steel."

**6.3 MAINTENANCE PAINTING:** The provisions of SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," should be followed.

**6.4 NUMBER OF COATS:** Minimum of one.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 100 micrometers (4.0 mils).

Provided by : www.spic.ir Licensee: NISOC Library

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS Guide 2.00
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM GUIDE NO. 2.00

## Guide for Selecting Alkyd Painting Systems*

Combinations of surface preparation, primers, intermediates, and topcoats may be selected for special situations for alkyd painting systems using the following Guide. To do so, select the desired surface preparation, primer, intermediate(s), and topcoat from those listed herein and insert them into the standard SSPC Painting System format. In order to aid in the selection, short comments are given. For additional information consult the "Commentary on Painting Systems" and the referenced standards.

### 1. Scope

**1.1** These specifications cover alkyd painting systems for commercial blast cleaned or pickled steel.

**1.2** These systems are suitable for use on parts or structures exposed in Environmental Zones 1A (interior, normally dry) and 1B (exterior, normally dry).

**1.3** The color of the finish paint must be specified.

### 2. Description

**2.1** This guide outlines the components of a complete alkyd painting system. A painting system shall consist of surface preparation by commercial blast cleaning or pickling, one coat of alkyd primer, one or two intermediate coat(s), and one finish coat.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 through 3.7 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 11*** | Red Iron, Zinc Chromate, Raw Linseed Oil and Alkyd Primer |
| **Paint 21** | White or Colored Silicone Alkyd Paint |
| **Paint 25** | Red Iron Oxide, Zinc Oxide, Raw Linseed Oil, and Alkyd Primer |
| **Paint 101** | Aluminum Alkyd Paint |
| **Paint 102** | Black Alkyd Paint |
| **Paint 103** | Black Phenolic Paint |
| **Paint 104** | White or Tinted Alkyd Paint |
| **Paint 108** | High-Build Thixotropic Leafing Aluminum Paint |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL SPECIFICATIONS AND STANDARDS:**

| | |
|---|---|
| **TT-E-489** | Enamel, Alkyd, Gloss (for Exterior and Interior Surfaces) |
| **TT-E-527** | Enamel, Alkyd, Lusterless |
| **TT-E-529** | Enamel, Alkyd, Semi-Gloss |
| **TT-P-645** | Primer Paint, Zinc Molybdate, Alkyd Type |

**3.7 AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO):**

| | |
|---|---|
| **M 69** | Aluminum Paint |

### 4. Surface Preparation

**4.1 SSPC-SP 6,** "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents, better degrees of blast cleaning shall be substituted (SSPC-SP 5 or 10).

Provided by : www.spic.ir Licensee: NISOC Library

COMMENT: Blast cleaning or pickling of the steel is the minimum recommended surface preparation for new work. Better degrees of blast cleaning (SSPC-SP 5 or 10) may be substituted. These methods are more thorough, and the better cleaning they provide may be more economical. In maintenance painting when only small areas need to be cleaned, hand or power tool cleaning (SSPC-SP 2 or 3) may suffice.

## 5. Paints

**5.1 ALKYD PRIMERS:** After cleaning, the steel shall be primed with one coat of paint conforming with one of the following specifications.

**5.1.1 Federal Specification TT-P-645,** "Primer, Paint, Zinc Molybdate, Alkyd Type":

COMMENT: TT-P-645 is pigmented with titanium dioxide and zinc molybdate (older formulations used zinc chromate.) It is particularly useful for alternate dry and wet areas. The vehicle has non-volatile alkyd resin with 23% phthalic anhydride.

**5.1.2 SSPC-Paint 11*,**"Red Iron Oxide, Zinc Chromate, Raw Linseed Oil and Alkyd Paint":

**5.1.3 SSPC-Paint 25,** "Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer":

COMMENT: SSPC-Paint 25 is an iron oxide, zinc oxide primer similar in composition to SSPCPaint 11 except that zinc chromate is replaced with zinc oxide.

**5.1.4 Proprietary Primer:**

COMMENT: A proprietary primer of proved performance capability may be substituted for any of the above if desired by the specifier. Specify the manufacturer, trade name, and product number of the desired proprietary paint. The paint manufacturer should furnish a typical label analysis.

**5.2 INTERMEDIATE COAT(S) FOR ALKYD PAINTING SYSTEMS:** The second coat of paint in a three-coat system may be the same as the first coat, but tinted with carbon black or lampblack paste in oil; or when stipulated, it may instead be the same as the finish coat (third coat), but tinted to contrast with the finish coat.

The primers listed above (particularly those of contrasting color) are suitable for intermediate coats. The primer or finish coat may also be used as the third coat of a four coat system, provided they are tinted to provide contrast with the preceding and following coats. If an aluminum finish coat is used, the next to last coat may be the same as the last (finish) coat except that the corresponding non-leafing pigment shall be used in place of leafing aluminum.

Alternatively, the intermediate coat(s) of paint shall conform with the following specification.

**5.2.1 SSPC-Paint 101,**"Aluminum Alkyd Paint," Type II, "Non-Leafing":

COMMENT: This non-leafing aluminum paint is suitable for use as an intermediate coat where the final paint coat is to be an aluminum paint and where longer weathering without the prime coat showing through the aluminum finish coat is desired.

**5.2.2 Proprietary Intermediate:**

COMMENT: A proprietary intermediate of proved performance capability may be substituted for any of the above if desired by the specifier. Specify the manufacturer, trade name and product number of the desired proprietary paint. The paint manufacturer should furnish a typical label analyst.

**5.3 ALUMINUM FINISH COATS:** The paint shall conform with one of the following specifications.

**5.3.1 SSPC-Paint 101,** "Aluminum Alkyd Paint," Type I "Leafing":

COMMENT: This aluminum alkyd paint has good stability, drying, and application properties as well as excellent durability in atmospheric exposures. Its lapping properties are fairly good. It is generally mixed on the job by adding two pounds of aluminum paste to one gallon of alkyd varnish vehicle.

**5.3.2 SSPC-Paint 108,** "High-Build Thixotropic Leafing Aluminum Paint":

COMMENT: Added protection is possible because of the thicker film which may be applied with this special high build composition.

**5.3.3. AASHTO Specification,** "Aluminum Paint," Designation M 69:

COMMENT: This is a ready to mix aluminum finish coat for bridges, and has an oleoresinous tung oil spar varnish vehicle.

**5.4 BLACK FINISH COATS:** The paint shall conform with one of the following specifications.

**5.4.1 SSPC-Paint 102,** "Black Alkyd Paint":

COMMENT: A very durable carbon black and long oil alkyd varnish paint which is recommended for severe exposures such as railroad bridges and industrial atmospheres.

**5.4.2 SSPC-Paint 103,** "Black Phenolic Paint":

COMMENT: A carbon black and silica phenolic varnish paint which is suitable for water immersion, high humidity, condensation, industrial atmospheres, or chemical environments.

Provided by : www.spic.ir Licensee: NISOC Library

**5.5 WHITE OR TINTED FINISH COATS:** If a colored finish coat is specified, the color and shade of color should be agreed upon among the contracting parties, using a suitable method of color designation. The paint shall conform with one of the following specifications.

**5.5.1 SSPC-Paint 104,** "White or Tinted Alkyd Paint":
COMMENT: A long oil alkyd paint that has good stability, drying, and application properties as well as excellent durability in atmospheric exposures, particularly industrial atmospheres.

**5.5.2 Federal Specification TT-E-489 Class A,** "Enamel, Alkyd, Gloss (for Exterior and Interior Surfaces)":
COMMENT: A series of medium oil, alkyd colored enamels, suitable for interior or exterior use; high gloss but low build per coat; particularly suited for machinery and similar equipment where appearance is important.

**5.5.3 Federal Specification TT-E-529 Class A,** "Enamel, Alkyd, Semi-Gloss":
COMMENT: Similar to preceding paint, but semi-gloss.

**5.5.4 Federal Specification TT-E-527,** "Enamel, Alkyd, Lusterless":
COMMENT: Similar to preceding two paints, but flat finish.

**5.5.5 SSPC-Paint 21,** "White or Colored Silicone Alkyd Paint," Type I, "High Gloss" or Type II, "Medium Gloss":
COMMENT: Silicone alkyd paints are highly weather resistant and are characterized by excellent color and gloss retention. Twelve colors are described under each type.

**5.6 PROPRIETARY FINISH PAINTS:**
COMMENT: A proprietary finish of proved performance capability may be substituted for any of the above if desired by the specifier. Specify the manufacturer, trade name, color, and product number of the desired proprietary paint. The manufacturer should furnish a typical label analysis.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 FIELD TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel" and in particular with the section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** The provisions of SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems" should be followed.
COMMENT: This guide covers the steps necessary for repainting previously painted steel surfaces.

**6.4 NUMBER OF COATS:** A minimum of three.
COMMENT: Three coats are required for usual conditions. Two coats will result in an uneconomically thin paint film, poorer coverage of the blast profile pattern, and shorter life in normal atmospheric exposures. Four coats are recommended in more severe exposures such as near the seashore and areas of high humidity.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 50 micrometers (2.0 mils); intermediate 38 micrometers (1.5 mils); finish 25 micrometers (1.0 mil); for a three-coat system 115 micrometers (4.5 mils); for a four-coat painting system 150 micrometers (6.0 mils).

## 7. Inspection

**7.1** All work and materials supplied under this specification is 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, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

**7.4** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

Provided by : www.spic.ir Licensee: NISOC Library

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

* This paint contains chromate pigments. Users are urged to follow all health, safety, and environmental requirements in applying, handling or disposing of these materials.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS Guide 3.00
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM GUIDE 3.00

## Guide for Selecting Phenolic Painting Systems

There are no standard painting systems for phenolic paints; however, by using the following Guide a painting system may be selected by the specifier. Select the desired surface preparation, primer, intermediate(s), and topcoat from those listed herein and insert them into the standard SSPC Painting System format. In order to aid in the selection, short comments are given. For additional information consult the "Commentary on Painting Systems" and the referenced standards.

### 1. Scope

**1.1** These specifications cover phenolic painting systems for blast cleaned steel.

**1.2** These systems are suitable for use on parts or structures exposed in Environmental Zones 1A (interior, normally dry), 1 B (exterior, normally dry), and 2A (frequently wet by fresh water).

**1.3** Phenolic paints will normally dry in about 12 hours. For optimum intercoat adhesion recoating should take place in less than 24 hours.

**1.4** The color of the finish paint must be specified.

### 2. Description

**2.1** This guide outlines the components of a complete phenolic painting system. A standard system consists of surface preparation by commercial blast cleaning or pickling, one coat of phenolic primer, one or two intermediate coat(s), and one finish coat.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Sections 3.4 through 3.6 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 5** | Zinc Dust, Zinc Oxide, and Phenolic Varnish Paint |
| **Paint 103** | Black Phenolic Paint |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 U.S. COAST GUARD SPECIFICATIONS:**

| | |
|---|---|
| **CGS-52** | Paint: Aluminum Ready Mixed |

### 4. Surface Preparation

**4.1 SSPC-SP 6,** "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents, better degrees of blast cleaning shall be substituted (SSPC-SP 5 or 10).

COMMENT: Blast cleaning or pickling of the steel is the minimum recommended surface preparation for new work. Better degrees of blast cleaning (SSPC-SP 5 or 10) may be substituted. These methods are more thorough, and the better cleaning they provide may be more economical or may be required for moderately corrosive conditions and immersion service.

### 5. Paints

**5.1 PHENOLIC PRIMERS:** After cleaning, the steel shall be primed with one coat of paint conforming with one of the following specifications.

Provided by : www.spic.ir Licensee: NISOC Library

**5.1.1 SSPC-Paint 5,** "Zinc Dust, Zinc Oxide, and Phenolic Varnish Paint":

COMMENT: This paint is suitable for fresh water immersion and atmospheric exposure. If used in salt water immersion or in chemical or industrial environments, then an inert topcoat must be used.

**5.1.2 Proprietary Primer:**

COMMENT: A proprietary primer of proved performance capability may be substituted for the above if desired by the specifier. Specify the manufacturer, trade name, and product number of the desired proprietary paint. The paint manufacturer should furnish a typical label analysis.

**5.2 INTERMEDIATE COAT(S) FOR PHENOLIC PAINTING SYSTEMS:** The second coat of paint in a three-coat system may be the same as the first coat, but tinted with carbon black or lampblack paste in oil; or when stipulated, it may instead be the same as the finish coat (third coat), but tinted to contrast with the finish coat.

The primers listed above (particularly those of contrasting color) are suitable for intermediate coats. The primer or finish coat may also be used as the third coat of a four-coat system, provided they are tinted to provide contrast with the preceding and following coats. If an aluminum finish coat is used, the next to last coat may be the same as the last (finish) coat except that the corresponding non-leafing aluminum pigment shall be used in place of leafing aluminum.

Alternatively, a proprietary intermediate of proved performance capability may be substituted for any of the above if desired by the specifier. Specify the manufacturer, trade name, and product number to identify the proprietary primer.

**5.3 PHENOLIC FINISH COATS:** The paint shall conform with one of the following specifications.

**5.3.1 U.S. Coast Guard Specification CGS-52,** "Paint Aluminum Ready Mixed":

COMMENT: Highly resistant to water immersion, high humidity, condensation, general atmospheric exposure, and mild chemical environments, but should not be used in strong alkaline environments.

**5.3.2 SSPC-Paint 103, "Black Phenolic Paint":**

COMMENT: A carbon black and silica phenolic varnish pain which is suitable for water immersion, high humidity, condensation, industrial atmospheres, or chemical environments. Color makes it difficult to inspect inside closed tanks.

**5.3.3 Proprietary Finish Paint:**

COMMENT: A proprietary finish paint of proved performance capability may be substituted for any of the above if desired by the specifier. Specify the manufacturer, trade name, product number, and color of the desired proprietary paint. The paint manufacturer should furnish a typical label analysis.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel":

COMMENT: Due to the hardness of many of the phenolic paints, intercoat adhesion difficulties can develop unless 24 hours or less drying time is allowed between coats.

**6.2 FIELD TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel" and in particular with the Section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** The provisions of SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems" should be followed.

COMMENT: This guide covers the steps necessary for repainting previously painted steel surfaces.

**6.4 NUMBER OF COATS:** A minimum of three.

COMMENT: Three coats are required for usual conditions. Two coats will result in an uneconomically thin paint film, poorer coverage of the blast profile pattern, and shorter life in normal atmospheric and immersion exposures. Four coats are recommended in more severe exposures.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 50 micrometers (2.0 mils); intermediate 38 micrometers (1.5 mils); finish 25 micrometers (1.0 mil); for a three-coat system 115 micrometers (4.5 mils); for a four-coat painting system 150 micrometers (6.0 mils).

## 7. Inspection

**7.1** All work and materials supplied under this specification is 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, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identifica-

Provided by : www.spic.ir Licensee: NISOC Library

tion for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

**7.4** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM GUIDE 4.00

## Guide for Selecting Vinyl Painting Systems*

Most needs for vinyl painting systems can be met by the standard SSPC Painting Systems 4.02 and 4.04 in this section. Other combinations of surface preparation, primer, intermediates, and topcoats may be selected for special situations for vinyl painting systems using the following Guide. To do so, select the desired surface preparation, primer, intermediate(s), and topcoat from those listed herein and insert them into the standard SSPC Painting System format In order to aid in the selection, short comments are given. For additional information consult the "Commentary on Painting Systems" and the referenced standards.

### 1. Scope

**1.1** This guide covers vinyl painting systems for blast cleaned or pickled steel.

**1.2** These systems are suitable for use on parts or structures exposed in Environmental Zones 1A (interior, normally dry), 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 2C (fresh water immersion), 2D (salt water immersion), 3A (chemical, acidic), and 3B (chemical neutral).

**1.3** The color of the finish paint must be specified.

### 2. Description

**2.1** This guide outlines the components of a complete vinyl painting system. A painting system shall consist of surface preparation by commercial blast cleaning or pickling, one coat of wash primer (when required), one coat of vinyl primer, one or two intermediate coat(s), and one finish coat of vinyl paint.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 through 3.8 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 8** | Aluminum Vinyl Paint |
| **Paint 9** | White (or Colored) Vinyl Paint |
| **Paint 27*** | Basic Zinc Chromate – Vinyl Butyral Wash Primer |
| **PS 4.02** | Four-Coat Vinyl Painting System (For Fresh Water, Chemical, and Corrosive Atmospheres) |
| **PS 4.04** | Four-Coat White or Colored Vinyl Painting System (For Fresh Water, Chemical, and Corrosive Atmospheres) |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL SPECIFICATIONS AND STANDARDS:**

| | |
|---|---|
| **MIL-L-2838** | (canceled) Lacquer, Vinyl Resin, Gasoline and Water Resistant |
| **MIL-P-15930** | Primer, Vinyl-Zinc Chromate Type, (for Hot Spray) |
| **MIL-E-15935** | (canceled) Enamel, Outside, Gray, Vinyl-Alkyd |
| **MIL-E-15936** | (canceled) Enamel, Exterior, Gray, No. 27 Vinyl-Alkyd |
| **MIL-E-16188** | (canceled) Enamel, Exterior, Gray, No. 17 (Vinyl-Alkyd) |
| **MIL-E-16738** | (canceled) Enamel, Exterior, White, (Vinyl-Alkyd) |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **MIL-E-24292** | (canceled) Enamel, Exterior, Dark Gray (Vinyl-Alkyd) |
| **MIL-E-24306** | (canceled) Enamel, Exterior, Black (Vinyl-Alkyd) |
| **MIL-E-24307** | (canceled) Enamel, Exterior, Gray (Vinyl-Alkyd) |
| **MIL-P-28641** | (canceled) Primer Coating, Vinyl Chloride Copolymer, High-Build (for Steel and Masonry) |
| **MIL-P-28642** | (canceled) Paint (Topcoat), Vinyl Chloride Acetate Copolymer, High Build (for Steel and Masonry) |
| **MIL-E-82401** | Enamel, Exterior, Vinyl-Alkyd, Red |

**3.7 US ARMY CORPS OF ENGINEERS STANDARDS:**

| | |
|---|---|
| **CW-09940** | Painting Hydraulic Structures and Appurtenant Works |
| **V-106** | Vinyl Type Red Oxide (Light or Dark Color) Paint |
| **V-766** | Vinyl-Type White (or Gray) Paint |
| **VZ-108** | Vinyl-Type Zinc-Rich Paint |

**3.8 U.S. BUREAU OF RECLAMATION STANDARDS:**

| | |
|---|---|
| **VR-3** | Vinyl Resin Paint |
| **VR-6** | Vinyl Resin Paint |
| **VR-M*** | Vinyl Resin Mastic |

## 4. Surface Preparation

**4.1 SSPC-SP 6,** "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents, better degrees of blast cleaning shall be substituted (SSPC-SP 5 or 10).

COMMENT: Blast cleaning or pickling of the steel is the minimum recommended surface preparation for new work. Better degrees of blast cleaning (SSPC-SP 5 or 10) may be substituted. The high degree of cleanliness provided by these cleaning methods may be more economical or may be required for corrosive conditions. In maintenance repainting when only small areas need to be cleaned, hand or power tool cleaning (SSPC-SP 2 or 3) may suffice.

The U.S. Bureau of Reclamation, the Corps of Engineers, and some others require that white metal (SSPC-SP 5) or near-white (SSPC-SP 10) blast cleaning is mandatory for vinyl coatings.

## 5. Paints

**5.1 WASH PRIMER:** If specified in the procurement documents, a wash primer complying with SSPC-Paint 27*, "Basic Zinc Chromate - Vinyl Butyral Wash Primer," shall be applied.

COMMENT: Use of a wash primer is recommended for salt water immersion. For fresh water immersion, however, the wash primer is no longer recommended by most manufacturers. The vinyl butyral wash primer should be applied to bare metal only. In spot pretreating care should be taken to minimize overlapping old paint.

**5.2 VINYL PRIMERS:** After cleaning, the steel shall be primed with one coat of paint conforming with one of the following specifications.

**5.2.1 U.S. Bureau of Reclamation Specification, VR-3,** "Vinyl Resin Paint."

COMMENT: This high solid vinyl paint is available in white, medium gray, and aluminum colors. The aluminum is recommended as a topcoat only. A three-coat system is used for interior oil service (125 micrometers/5 mils minimum) and four-coat systems are used as interior lining for water service or for exterior service in water and sunlight (150 micrometers/6 mils minimum thickness). The white and medium gray are pigmented with titanium dioxide, extenders, and black tint. They are formulated with vinyl tripolymer and copolymer to meet requirements for overall composition, density, application, dry (three-hour recoat), stability, adhesion and cohesion, flexibility, permeability, resistance to solvent, salt-spray, and abrasion.

**5.2.2 U.S. Bureau of Reclamation Specification VR-6,"**Vinyl Resin Paint":

COMMENT: This system is similar to VR-3 except that it requires three intermediate coats and two finish coats for a total of 250 micrometers (10.0 mils) minimum dry film thickness. Complete system is intended especially for exterior service in water and sunlight.

**5.2.3 Corps of Engineers Specification V-106,**"Vinyl Type Red Oxide (Light or Dark Color) Paint":

COMMENT: Corps of Engineers Specification CW-09940, "Painting: Hydraulic Structures and Appurtenant Works," describes four- and five-coat paint systems using this and the following two primers.

**5.2.4 Corps of Engineers Specification V-766,**"Vinyl-Type White (or Gray) Paint":

COMMENT: See comment under Section 5.2.3.

**5.2.5 Corps of Engineers Specification VZ-108,** "Vinyl-Type Zinc-Rich Paint":

COMMENT: See comment under Section 5.2.3.

**5.2.6 Federal Specification MIL-P-15930*,** "Primer, Vinyl-Zinc Chromate Type, (for Hot Spray)":

COMMENT: The zinc chromate vinyl paint is similar to the above, but it is not used as widely on steel. It is not recommended for fresh water use.

Provided by : www.spic.ir Licensee: NISOC Library

**5.2.7 Federal Specification MIL-L-2638,** "Lacquer, Vinyl Resin, Gasoline and Water Resistant":

COMMENT: This system is intended for coating storage tanks and pipes. Pigments selected must be suitable for potable water service as defined by the Environmental Protection Agency.

**5.2.8 SSPC-Paint 9,** "White (or Colored) Vinyl Paint":

COMMENT: SSPC-Paint 9 is a white vinyl paint that may also be procured in tints. It can be used as a primer over wash primer or over bare steel and as an intermediate or finish paint over any vinyl paint. It is highly recommended as an inert pigmented vinyl paint for extremely severe chemical exposure that could attack wash primer pigments or other vinyl paint pigments.

**5.2.9 Proprietary Primer:**

COMMENT: A proprietary primer of proven performance capability may be substituted for any of the above if desired by the specifier. Specify the manufacturer, trade name, and product number of the desired proprietary paint.

**5.3 INTERMEDIATE COAT(S) FOR VINYL PAINTING SYSTEMS:** The second coat of paint in a three-coat system may be the same as the first coat, but tinted to contrast with the primer; or when stipulated, it may be the same as the finish coat (third coat), but tinted to contrast with the finish coat. Paints shall be tinted by the manufacturer; otherwise only lampblack dispersed in vinyl chlorideacetate copolymer resin solution or similar black vinyl paint shall be used for tinting.

The primers listed above (particularly those of contrasting color) are suitable for intermediate coats. The primer or finish coat, except aluminum finish coats, may also be used as the third coat of a four-coat system, provided they are tinted to provide contrast with the preceding and following coats. If an aluminum finish coat is used, the next-to-last coat may be the same as the last (finish) coat except that the corresponding non-leafing pigment shall be used in place of leafing aluminum. Alternatively, the intermediate coat(s) of paint shall conform with the following specifications.

**5.3.1 U.S. Bureau of Reclamation Specification VR-M*,** "Vinyl Resin Mastic":

COMMENT: Used in conjunction with VR-3 and VR-6 vinyl paints, this high build coating is applied at bolts, rivets, and sharp corners.

**5.3.2 Proprietary Intermediate:**

COMMENT: A proprietary intermediate of proven performance capability may be substituted for any of the above if desired by the specifier. Specify the manufacturer, trade name, and product number of the desired proprietary paint.

**5.4 VINYL FINISH COATS:** The paint shall conform with one of the following specifications.

**5.4.1 SSPC-Paint 8,** "Aluminum Vinyl Paint":

COMMENT: SSPC-Paint 8 is an aluminum paint that may be used over any vinyl paint as a finish coat. Aluminum topcoats are preferred for water immersion, but not for use in alkaline or strongly acid exposures. This paint should not be used under other vinyl paints or applied in overly thick films (e.g., 75 micrometers/3 mils per coat) because of the possibility of solvent entrapment by the aluminum flake.

**5.4.2 SSPC-Paint 9,** "White (or Colored) Vinyl Paint":

COMMENT: An inert pigmented straight vinyl paint suitable for chemical exposures which may be used as a primer or an intermediate finish coat. It may be procured in colors by specifying the color desired and substituting suitable colored pigment for the titanium dioxide.

**5.4.3 U.S. Bureau of Reclamation Specification VR-3,** "Vinyl Resin Paint":

COMMENT: This vinyl coating is described under primers. Either the white, gray, or aluminum types may be used as finish coats, although the aluminum paint is not recommended for use as a primer or intermediate coat, nor is it recommended for use in alkali or strong acid. Because of its superior impermeability, however, it is the preferred topcoat for other services such as water immersion or exterior sunlight.

**5.4.4 U.S. Bureau of Reclamation Specification VR-6,** "Vinyl Resin Paint":

COMMENT: Vinyl coating system provides for white, black, color, and an aluminum topcoat as described in VR-3.

**5.4.5 Proprietary Finish Paints:**

COMMENT: A proprietary finish of proven performance capability may be substituted for any of the above if desired by the specifier. Specify the manufacturer, trade name, color, and product number of the desired proprietary paint.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel":

COMMENT: To obtain the required thickness per coat, without pinholing or sagging, airless spray or hot spray with multiple passes are helpful. Single wet coats more than 75 to 125 micrometers (3 to 5 mils) thick, on the other hand, can lead to solvent release problems unless specially formulated highbuild coatings are used.

Sufficient time should be allowed for air drying between coats to assure essentially complete solvent removal. Dry to touch is not a good indication of complete dryness since

Provided by : www.spic.ir Licensee: NISOC Library

retained solvent is very slow to diffuse out, and if not removed, greatly reduces resistance and durability of the paint film. Air dry as much as 24 hours between coats is desirable if feasible.

**6.2 FIELD TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel" and in particular with the Section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** For maintenance painting procedures, see SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems."

COMMENT: This guide covers the steps necessary for repainting previously painted steel surfaces.

**6.4 NUMBER OF COATS:** A minimum of three.

COMMENT: A minimum of three coats of conventional vinyl paint are recommended for the less severe exposures. For very severe exposures, four coats are recommended; and for extremely severe exposures, five or six coats may be required. Complete immersion in corrosive liquids requires thick films and consequently more coats.

Two coats of conventional vinyls on structural steel will result in an uneconomically thin paint film. The thin paint film results in short life of the coating due to inadequate coverage of the blast profile pattern.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** For conventional vinyl coatings not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": wash primer, when required, 8 micrometers (0.3 mils); primer 33 micrometers (1.3 mils); for a three-coat painting system 100 micrometers (4.0 mils); for a four-coat painting system 125 micrometers (5.0 mils); for a five-coat painting system 150 micrometers (6.0 mils).

COMMENT: Conventional vinyl coatings contain a high level of solvent and are best applied by air spray in coats of not more than 50 micrometers (2 mils) each. High-build vinyl coatings especially formulated for airless spray can be applied up to 125 micrometers (5 mils) dry film thickness with proper equipment and technique. If done improperly, excessive amounts of solvents can be retained in the dry coating.

## 7. Inspection

**7.1** All work and materials supplied under this specification is 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**9.2** Most vinyl paints listed in this specification are compatible with one another; however, several precautions shall be taken when using vinyl paints. The vinyl paint should be vinyl chloride acetate copolymer, modified by carboxyl or hydroxyl groups if required. Some vinyl primers are satisfactory over wash primer only, some over bare steel only, while some may be used over either. Some vinyl paints will not adhere to wash primers, but must be used over a suitable intermediate coat (many proprietary vinyl paints are of this type).

**9.3** Vinyl painting systems are excellent for very severe exposures, including most chemical atmospheres, fresh and salt water immersion, and corrosive environments. Discretion should be exercised when used for immersion in corrosive chemicals such as inorganic acids, alkalis, and salts or in liquids such as aliphatics, alcohols, oils, and

Provided by : www.spic.ir Licensee: NISOC Library

grease. However, they are dissolved by some organic solvents such as aromatics, ketones, ethers, and esters, and attacked by some chemicals such as fuming nitric acid, 98% sulfuric acid, and acetic acid.

* These paints contain lead or chromate. Users are urged to follow all health, safety, and environmental requirements in applying, handling or disposing of these materials.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 4.02
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 4.02

## Four-Coat Vinyl Painting System (For Fresh Water, Chemical, and Corrosive Atmospheres)

### 1. Scope

**1.1** This specification covers a complete vinyl painting system for structural steel.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zones 2C (fresh water immersion), 3A (chemical exposure, acidic), and 3B (chemical exposure, neutral).

**1.3** The finish paint allows for a choice of colors.

### 2. Description

**2.1** This painting system consists of surface preparation by near-white blast cleaning or pickling and four coats of U.S. Bureau of Reclamation VR-3, "Vinyl Resin Paint."

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 through 3.6 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 U.S. BUREAU OF RECLAMATION STANDARD:**

| | |
|---|---|
| **VR-3** | Vinyl Resin Paint |

### 4. Surface Preparation

**4.1** SSPC-SP 10, "Near-White Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents, a better degree of cleaning shall be substituted (SSPC-SP 5, "White Metal Blast Cleaning").

### 5. Paints

**5.1 PRIMER:** U.S. Bureau of Reclamation Specification VR-3, "Vinyl Resin Paint."

**5.2 SECOND COAT:** U.S. Bureau of Reclamation Specification VR-3, "Vinyl Resin Paint," tinted to a color contrasting with the primer and the third coat.

**5.3 THIRD COAT:** U.S. Bureau of Reclamation Specification VR-3, "Vinyl Resin Paint," tinted to a color contrasting with the second coat and the finish paint.

**5.4 FINISH COAT:** U.S. Bureau of Reclamation Specification VR-3, "Vinyl Resin Paint."

### 6. Paint Application

**6.1 PAINT APPLICATION:** Follow the requirements SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and in particular with the section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** For maintenance painting procedures, see SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems."

Provided by : www.spic.ir Licensee: NISOC Library

**6.4 NUMBER OF COATS:** Minimum of four.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 38 micrometers (1.5 mils); for the four- coat painting system 150 micrometers (6.0 mils).

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**9.2** The painting system is intended primarily for structural steel exposed to fresh water immersion, condensation, very severe weather, or chemical atmospheres. It may be used with discretion for immersion in corrosive chemicals such as inorganic acids, alkalis, and salts or in liquids such as aliphatics, alcohols, oils, and grease. However, it is dissolved by some organic solvents such as aromatics, ketones, ethers, and esters, and attacked by some chemicals such as fuming nitric acid, 98% sulfuric acid, and acetic acid.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 4.04
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 4.04

## Four-Coat White or Colored Vinyl Painting System (For Fresh Water, Chemical, and Corrosive Atmospheres)*

### 1. Scope

**1.1** This specification covers a complete vinyl painting system for structural steel.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zones 2B (frequently wet by salt water), 2C (fresh water immersion), 3A (chemical exposure, acidic), and 3B (chemical exposure, neutral).

**1.3** The finish paint allows for a choice of colors.

### 2. Description

**2.1** This painting system consists of surface preparation by commercial blast cleaning or pickling, wash primer when specified, and four coats of white (or colored) vinyl paint. Aluminum and black vinyl paints are alternative finish coats.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 8** | Aluminum Vinyl Paint |
| **Paint 9** | White (or Colored) Vinyl Paint |
| **Paint 27*** | Basic Zinc Chromate – Vinyl Butyral Wash Primer |
| **Paint 106** | Black Vinyl Paint |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1** SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents, a better degree of cleaning shall be substituted (SSPC-SP 10, "Near-White Blast Cleaning," or SSPC-SP 5, "White Metal Blast Cleaning").

### 5. Paints

**5.1 WASH PRIMER:** If specified in the procurement documents, a wash primer complying with SSPC-Paint 27*, "Basic Zinc Chromate-Vinyl Butyral Wash Primer," shall be applied.

**5.2 PRIMER:** SSPC-Paint 9, "White (or Colored) Vinyl Paint," tinted with lampblack dispersed in vinyl or with similar vinyl black paint to a color contrasting with the second coat.

**5.3 SECOND COAT:** SSPC-Paint 9, "White (or Colored) Vinyl Paint."

**5.4 THIRD COAT:** SSPC-Paint 9, "White (or Colored) Vinyl Paint," tinted with lampblack dispersed in vinyl or with similar vinyl black paint to a color contrasting with the second coat and the finish paint.

**5.5 FINISH COAT:** SSPC-Paint 9, "White (or Colored) Vinyl Paint."

**5.6 ALTERNATIVE FINISH COAT:** If specified in the procurement documents, a finish coat complying with specification SSPC-Paint 8, "Aluminum Vinyl Paint," shall be applied in place of the standard finish coat.

**5.7 ALTERNATIVE FINISH COAT:** If specified in the procurement documents, a finish coat complying with speci-

Provided by : www.spic.ir Licensee: NISOC Library

fication SSPC-Paint 106, “Black Vinyl Paint,” shall be applied in place of the standard finish coat.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow the requirements of SSPC-PA 1, “Shop, Field, and Maintenance Painting of Steel.”

**6.2 TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, “Shop, Field, and Maintenance Painting of Steel,” and in particular with the section thereof entitled “Field Painting.”

**6.3 MAINTENANCE PAINTING:** For maintenance painting procedures, see SSPC-PA Guide 4, “Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems.”

**6.4 NUMBER OF COATS:** Minimum of four in addition to the wash primer.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, “Measurement of Dry Coating Thickness with Magnetic Gages”: wash primer, when required, 8 micrometers (0.3 mils); primer 33 micrometers (1.3 mils); for the four-coat painting system 125 micrometers (5.0 mils).

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer’s name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**9.2** This painting system is intended primarily for structural steel exposed to chemical solutions, condensation, very severe weather, or chemical atmospheres. It may also be used for the interiors of buildings which are subjected to very corrosive conditions such as chemical fumes, high humidity, and heavy condensation; for floor systems of bridges exposed to brine drippings or de-icing salts; for potable water tanks; and for most chemical exposures including dry ladings of chemicals. It is not generally recommended for constant immersion at temperatures in excess of 66°C (155°F), but it may be used at temperatures up to 82°C (180°F) for atmospheric exposure, spillage, or short or infrequent immersion.

* This paint contains chromate pigments. Users are urged to follow all health, safety, and environmental requirements in applying, handling or disposing of these materials.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS Guide 7.00
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM GUIDE 7.00

## Guide for Selecting One-Coat Shop Painting Systems

There are no standard one-coat shop painting systems; however, by using the following Guide a painting system may be selected by the specifier. Select the desired surface preparation and primer from those listed and insert them into the standard SSPC Painting System format. In order to aid in the selection, short comments are given. For additional information consult the "Commentary on Painting Systems" and the referenced standards.

### 1. Scope

**1.1** This guide covers one-coat shop painting systems for steel that will not be exposed to corrosive conditions for long periods. They are also suitable for steel encased in concrete in those cases where bonding of steel to concrete is not required. They can be used under fireproofing.

**1.2** These systems are suitable for use on parts or structures exposed in Environmental Zones 0 (encased in concrete or masonry, normally dry) and 1A (interior, normally dry).

COMMENT: These one-coat painting systems are not expected to protect steel exposed to the weather for periods longer than six months in normal rural and industrial areas and for even shorter exposure periods for heavy industrial or marine exposures. They can be used on open frames or structural steel in buildings not subjected to high humidity, condensation, or corrosive fumes.

**1.3** The paints covered by this guide are primers, and if a color other than the standard color is required, then the color must be specified.

### 2. Description

**2.1** This guide outlines the components of a complete one-coat shop painting system. A painting system shall consist of surface preparation by hand or power tool cleaning and one coat of an inexpensive shop primer.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Sections 3.4 through 3.6 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness with Magnetic Gages |
| **Paint 25** | Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer |
| **PS Guide 1.00** | Guide to Selecting Oil Base Painting Systems |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |
| **SP 14/NACE No. 8** | Industrial Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL STANDARDS:**

| | |
|---|---|
| **A-A-1632** | Varnish, Asphalt |
| **TT-E-489** | Enamel, Alkyd, Gloss (Low VOC Content) |
| **TT-P-31** | (canceled) Paint, Oil: Iron Oxide, Ready Mixed, Red and Brown [Use SSPC-Paint 25] |
| **TT-V-51** | (canceled) Varnish, Asphalt [Use A-A-1632] |

### 4. Surface Preparation

**4.1 SSPC-SP 2,** "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning":

COMMENT: Blast cleaning (SSPC-SP 5, 6, 7, 10, or 14) or pickling (SSPC-SP 8) may be substituted. However, for economy, hand or power tool cleaning are generally used with the primers in this painting system guide. The

Provided by : www.spic.ir Licensee: NISOC Library

primers have fair to good wetting ability and do not require removal of all tight rust and tight mill scale if used in normal or mild atmospheric exposures. However, blast cleaning and pickling surface preparation methods are considered more thorough, and the better cleaning they provide may be more economical or may be required for moderately corrosive conditions. They are therefore very satisfactory alternatives unless warping, safety, or other special considerations make them impractical in particular cases.

## 5. Paints

**5.1 SHOP PRIMERS:** After cleaning, the steel shall be primed with one coat of paint conforming with one of the following specifications.

**5.1.1 Federal Specification TT-P-31*, "Paint Iron Oxide, Ready Mixed, Red and Brown":**

COMMENT: A slow drying iron oxide and linseed oil paint containing zinc oxide and varnish. Very good wetting and high build per coat results in greatly increased protection outdoors.

**5.1.2 Federal Specification TT-V-51**, "Varnish, Asphalt":**

COMMENT: A semi-quick drying paint consisting of asphalt varnish. This paint is black and bleeds through most topcoats.

**5.1.3 Proprietary Primer:**

COMMENT: A proprietary primer of proved performance capability may be substituted for any of the above if desired by the specifier. Specify the manufacturer, trade name, and product number of the desired proprietary paint. The paint manufacturer should furnish a typical label analysis.

**5.2 FINISH COATS:** No finish coat shall be required unless otherwise specified.

COMMENT: With one exception, the primers given in this painting system guide can be topcoated without difficulty and are compatible with the finish paints listed in SSPC-PS Guide 1.00, "Guide for Selecting Oil Base Painting Systems"; however TT-V-51** bleeds through most paints. For finish coats of hard drying, medium, or short oil alkyd paints use TT-E-489.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel" and in particular with Section thereof entitled "Field Painting."

**6.3 NUMBER OF COATS:** Minimum of one.

**6.4 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC- PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 38 micrometers (1.5 mils). If additional coats are to be applied each coat shall not be less than 25 micrometers (1.0 mil).

## 7. Inspection

**7.1** All work and materials supplied under this specification is 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, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

**7.4** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

*TT-P-31 was canceled. Use SSPC-Paint 25.

**TT-V-51 was canceled. Use A-A-1632.



Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS Guide 8.00
August 1, 1992
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM GUIDE NO. 8.00

## Guide to Topcoating Zinc-Rich Primers

### 1. Scope

**1.1** This guide covers the selection and application (including surface preparation) of topcoats to surfaces coated with zinc-rich primer. Both organic and inorganic zinc-rich primers are included.

**1.2** The guide does not cover the selection and application of the zinc-rich primer.

### 2. Description

**2.1** This guide represents good practice for topcoating zinc-rich primers as determined by industry consensus. It may not be applicable to all materials and conditions encountered.

**2.2** Zinc-rich primers are topcoated to provide extended exterior durability in severe exposures; to improve color, gloss, and other appearance properties; and to provide resistance to specific conditions such as highly acidic or highly basic environments.

**2.3** Information on the use of one-coat zinc-rich painting systems is provided in SSPC Painting System Specification 12.01.

**2.4 DEFINITIONS:**

**2.4.1 Bubbling:** The phenomenon caused by air or solvent vapors rising out of primer pores and being trapped because the topcoat has skinned over.

**2.4.2 Burnishing:** The polished effect that results from rubbing a zinc-rich primed surface.

**2.4.3 Crater:** A small bowl-shaped depression in a coating film.

**2.4.4 Curing (cure):** The process whereby an applied coating film achieves its ultimate physical and chemical properties. Cure time and dry time are generally not identical, as curing may continue after coating is dry to touch.

**2.4.5 Dry spray:** The condition that results from the paint losing too much solvent before reaching the substrate. Dry overspray is a nonadherent form of dry spray consisting of discontinuous particulate, which occurs when dry paint particles are deposited on an otherwise acceptable surface.

**2.4.6 Gassing:** See Bubbling.

**2.4.7. Mist coats:** Very thin spray coats, usually about one-fourth of the required wet film thickness. The application of a mist coat prior to the application of a full topcoat is used to minimize pinholing, bubbling, and cratering of the topcoat system.

**2.4.8 Mudcracking:** A surface condition characterized by cracks that extend into the body of the zinc-rich primer. The appearance of the surface is that of a dried mud puddle.

**2.4.9 Pinhole:** A film defect characterized by small porelike flaws in a single coat which extend entirely through that coat and have the general appearance of pin pricks when viewed by reflected light. The term is generally applied to holes caused by solvent bubbling, moisture, other volatile products, or the presence of extraneous particles in the applied film.

**2.4.10 Primer:** The first complete coat of paint of a painting system applied to a substrate.

**2.4.11 Tie coat:** An intermediate coat used to bond different types of paint coats.

**2.4.12 Topcoat:** The coating intended to be the last coat applied in a coating system. The topcoat is usually applied over a primer, under-coats, or surfacers. It is also known as finish coat.

**2.4.13 Wash coat:** A very thin, semi-transparent coat of paint, applied as a preliminary coating on a surface, which acts as a sealer or tie coat.

**2.4.14 Zinc-rich primer:** An anti-corrosive primer for steel incorporating zinc dust in a concentration sufficient to give electrical conductivity in the dried film, which enables the zinc metal to corrode preferentially to the substrate, i.e., to give cathodic protection.

**2.4.15 Zinc salt formation:** A non-uniform white discoloration on the surface of a zincrich paint produced by reaction of zinc dust with atmospheric constituents. It is sometimes referred to as “white rust.”

Provided by : www.spic.ir Licensee: NISOC Library

## 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Sections 3.2 through 3.3.

**3.2 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **Paint 20** | Zinc-Rich Primers (Type I - Inorganic and Type II - Organic) |
| **Paint 27*** | Basic Zinc Chromate – Vinyl Butyral Wash Primer |
| **Paint 29** | Zinc Dust Sacrificial Primer, Performance-Based |
| **PS Guide 12.00** | Guide for Selecting Zinc-Rich Painting Systems |
| **PS 12.01** | One-Coat Zinc-Rich Painting System |
| **SP 1** | Solvent Cleaning |

**3.3 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 3359** | Test Methods for Measuring Adhesion by Tape Test |
| **D 4541** | Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers |
| **D 4752** | Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub |

## 4. Selection of Topcoat

**4.1 IDENTIFY PRIMER:** Proper selection of topcoats requires identification of the generic (chemical) type of primer. Often the specific product name is needed as well. First determine the class of primer in accordance with SSPC-Paint 20, which categorizes zinc-rich primers by the type of vehicle and curing mechanism. If the primer has already been applied, record the date of application, manufacturer's name, product identification, batch number, and manufacturing date. If the primer has been selected but not applied, record the name of the manufacturer and the product designation. It is good painting practice to obtain the primer, intermediate coat (if any), and topcoat from the same manufacturer.

**4.2 COMPATIBILITY CONSIDERATIONS:** When topcoating zinc-rich primers, consideration must be given to the fact that zinc is being coated, not steel. Coatings based on drying oils, such as most oil and alkyd types, tend to react with the zinc metal to form zinc soaps, resulting in loss of adhesion and peeling of the topcoat. Coatings that have poor alkali resistance should not be applied directly to zinc-rich primers. In general, oil-containing vehicles such as oil paints, alkyd enamels, vinyl alkyds of the oxidizing type, long-oil silicone alkyds, and epoxy esters should not be applied directly to zinc-rich primers.

**4.3 SELECT COMPATIBLE TOPCOAT:** Table 1 lists commonly used zinc-rich primers and topcoats. For each combination, this table indicates the degree of acceptability, ranging from A (used directly) to E (not recommended). If the primer type has previously been identified, select a topcoat based on the information in 4.1, 4.2, Table 1, and Note 7.1. If the primer has not been identified, select a primer based on the information in 4.2, Table 1, and Note 7.2.

## 5. Surface Preparation and Repair of Primer

**5.1 IDENTIFY AND REPAIR DEFECTS:** The zinc-rich primer to be topcoated must be inspected for defects, and the defects must be repaired before the application of a topcoat. These defects include red rust, low dry film thickness (DFT), high DFT, dry overspray, mudcracking, foreign matter, and loose zinc salts. The coating manufacturer should supply recommended procedures for the repair of defects. Some general guidance is provided below.

**5.1.1 Red Rust:** Red rust resulting from the corrosion of the steel substrate and loose deposits of rust stain must be removed. However, light adherent stain, resulting from rust running from adjacent rusted areas, need not be removed. As there are many different acceptable repair procedures, the manufacturer's recommendations should be considered.

**5.1.2 Low Dry Film Thickness:** The dry film thickness should be measured in accordance with SSPC-PA 2. Low dry film thickness should be repaired before topcoating, based upon the recommendations of the zinc-rich primer manufacturer.

**5.1.3 Excessive Dry Film Thickness:** Excessive film thickness above maximum acceptable levels should be repaired by complete removal and reapplication of the primer. The amount of zinc-rich primer that is excessive is highly dependent on the formulation, the environment, the requirements for use, and the curing conditions. The most common value for maximum acceptable DFT is 125 to 150 micrometers (5 to 6 mils), based on a survey of suppliers, specifiers and applicators. For some zinc-rich primers, the maximum DFT may be as low as 90 micrometers (3.5 mils), while for certain organic zinc-rich primers a maximum DFT of 250 micrometers (10 mils) is acceptable.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**Acceptability of Primer/Topcoat Combinations[1]**
**Generic Type of Pimer**

| | Inorganic Zinc-Rich Primer | | | Organic Zinc-Rich Primer | |
|---|---|---|---|---|---|
| | Post-Cure Water-Borne Type 1A[2] | Self-Cure Water-Borne Type 1B | Self-Cure Solvent-Borne Type 1C | Thermoplastic (Solvent Evaporation Cure) Type IIA | Thermoset (Chemical Cure) Type IIB |
| **Topcoat** | | | | | |
| Vinyl | B | B | B | C | B |
| Epoxy[3] | A | A | A | E | A |
| Acrylic Solution | D | D | D | B | A |
| Chlorinated Rubber | B | B | A | A | A |
| Polyurethane[4] | B | B | B | B | B |
| Phenolic | B | B | B | E | A |
| Silicone | A | B | A | B | B |
| Alkyd | E | E | E | E | E |
| Epoxy Ester | D | D | D | D | D |
| Silicone Alkyd | D | D | D | D | D |
| Oil Urethane | D | D | D | D | D |
| Oil Phenolic | D | D | D | D | D |
| Linseed Oil | D | D | D | D | D |
| Coal Tar Epoxy | B | B | B | E | A |
| Vinyl Alkyd | D | D | D | D | D |

A Generally used directly on zinc with no difficulties.
B Some formulations can be used directly; others require a tie-coat.
C Lifting of zinc-rich primer is likely to occur unless well aged.
D Not recommended unless tie-coat is added.
E Not recommended.

[1] These are general guidelines, not hard and fast rules. This list is not exhaustive. Always consult the manufacturer's recommendation.
[2] See SSPC-Paint 20.
[3] Chemical cure such as epoxy amine, epoxy polyamide, epoxy polyamine, or epoxy phenolic.
[4] Must be oil-free and alkali resistant.

**5.1.4 Dry Overspray:** A piece of wadded-up screen wire or screening attached to a wooden block may be used to remove dry overspray (defined in 2.4.5). In the latter case, the wooden block may be shaped to fit the structural members involved. Tightly adhering zinc coats should not be removed.

**5.1.5 Mudcracking:** This condition (defined in 2.4.8) usually results from excessive dry film thickness in a single coat. Mudcracking that is visible without magnification shall be corrected according to the manufacturer's recommendations This defect can occur anywhere, but it is most likely to occur at inside corners and fillet welds.

**5.1.6 Foreign Materials:** Dirt, mud, grease, oil, and other foreign materials must be removed prior to topcoating. Usually detergent and solvent cleaning, in accordance with SSPC-SP 1, are sufficient. The manufacturer of the primer and topcoat may be contacted for specific recommendations.

**5.1.7 Zinc Salts:** Zinc-rich primers may form varying types and amounts of surface salts depending upon exposure. Loose zinc salts must be removed prior to topcoating, as they may have detrimental effects on the coating system. Such salts may be removed by fresh water washing and scrubbing. To achieve satisfactory results when topcoating post-cured inorganic zinc primers, it is important to clean the cure residue from the surface before applying topcoats. Normally, this is done by water washing, using a stiff bristle brush for stubborn residues.

Adherent zinc salts need not be removed for atmospheric exposure service (Note 7.3). Under immersion service, however, water-soluble zinc salts, even if adherent, may cause blistering or other problems when the zinc-rich primer is topcoated (Note 7.4). Such water-soluble

Provided by : www.spic.ir Licensee: NISOC Library

salts should be removed by thorough fresh water washing and scrubbing prior to the application of the topcoat. Wetted surfaces must be dry prior to the application of the topcoat.

**5.2 ENSURE ADEQUACY OF CURE:** The film formation of most zinc-rich primers includes solvent evaporation (drying) and chemical reaction (curing). To properly receive a topcoat, the primer must be adequately dried and cured. Typically, 90% or more of the solvent will evaporate within the first 15 minutes. Completion of the chemical reaction of curing may require weeks or months; however, the primer can receive a topcoat in a shorter period of time than required for full curing (see Note 7.5).

**5.2.1 Factors That Affect Cure:**

**5.2.1.1 Humidity:** Depending on the type of primer, the time to cure can be significantly altered by humidity conditions. Many primers (especially solvent-borne inorganic) do not cure below 40% relative humidity. For some primers in low humidity environments, the application of a thin film of water after the initial drying can be used to promote curing mechanisms. In humidity over 90%, some water-borne inorganic zinc primers do not properly cure.

**5.2.1.2. Temperature:** The time to cure and the extent of cure for many zinc-rich primers is also affected by temperature. The manufacturer should be contacted for specific recommendations regarding temperature and humidities for curing prior to topcoating.

**5.2.1.3 Dry Film Thickness:** For almost all zinc-rich primers, thicker films require longer cure times. Solvent-borne inorganic zinc-rich primers, especially the single-component types, are particularly sensitive to this effect. No published data comparing dry film thickness to cure time could be found.

**5.2.2 Methods to Assess Adequacy of Cure:** The recommendations of the zinc-rich primer manufacturers are the most important factors in determining the adequacy of cure of a zincrich primer. Some general methods for determining zinc-rich primer cure are listed below:

**5.2.2.1 Solvent Rub:** This method is only applicable to ethyl silicate zinc-rich primers which do not have butyl or other organic modifiers. As described in ASTM D 4752, a clean rag soaked in methyl ethyl ketone (or other suitable solvent) is rubbed over the primer 50 times. No residue, or only traces of residue on the rag, indicates adequate cure.

**5.2.2.2 Coin Rub:** A quick and easy method to assess adequacy of cure is to rub the primer with the edge of a coin; if the film burnishes, it is acceptable. Some zinc-rich primers which do not burnish may still be acceptable for topcoating, if so indicated by the manufacturer.

**5.2.3 Correcting Undercured Inorganic Zinc Primer:**

**5.2.3.1** If the inorganic zinc-rich primer is undercured due to insufficient humidity, proper curing may be achieved by a longer curing time, or by curing at a high humidity level, achieved through natural weather variations or artificial means, such as spraying the primed surface with water.

**5.2.3.2** Undercured water-borne inorganic zinc-rich primers may be corrected by furnishing clean, dry air to aid in water evaporation. In some cases, an acidic post-curing solution may be applied, followed by thorough rinsing.

**5.2.3.3** If it is determined that the inorganic zinc-rich primer is not cured and cannot attain a satisfactory condition for topcoating, the zinc-rich primer must be removed, and a new primer must be applied. This condition is generally due to excessive solvent retention or insufficient reaction of the vehicle with oxygen, moisture, or catalyst.

## 6. Application of Topcoats

**6.1 GENERAL:**

**6.1.1** The surface of the zinc-rich primer to be topcoated should be free of loose zinc salts, dry spray, foreign materials, and other defects described in Section 5.1. The primer should be free of moisture. (See Note 7.6.)

**6.1.2** The primer should be adequately cured as described in Section 5.2, based on the requirements of the primer manufacturer.

**6.1.3** The topcoat application should be in accordance with SSPC-PA 1.

**6.1.4** Factors that affect the acceptability and performance of a topcoated zinc-rich primer include porosity of primer, extent of topcoat bubbling, and adhesion of topcoat. General guidelines are given below.

**6.2 POROSITY OF PRIMERS:** A zinc-rich primer consists of particles of zinc metal bound to each other by a suitable inorganic or organic binder. The zinc dust content of the dry film may vary from 74 to 95 percent of the total weight. (See Note 7.7.) The small amount of binder results in a very high pigment volume concentration for both organic and inorganic zinc-rich primers, resulting in a porous coating. Porosity becomes more pronounced if the zinc-rich primer is dry sprayed, the weather is hot, the equipment is improperly adjusted, or the applicator fails to apply the zinc-rich primer in a full wet coat. These conditions contribute to pinholing, bubbling, and cratering of the topcoat, the sever-

Provided by : www.spic.ir Licensee: NISOC Library

ity of which may vary with the type of binder used.

**6.3 TOPCOAT BUBBLING AND PINHOLING:**

**6.3.1 Origin of Bubbles and Pinholes:** If the topcoat is capable of penetrating the pores and forming a film, this penetration may provide a base for initial adhesion. However, when organic topcoats and their solvents penetrate into the pores of the primer, they may also force air up through the wet film of paint. A bubble or crater results if the surface has "skinned over" or has lost its ability to flow. Pinholes may also occur under these circumstances (see 2.4.1, 2.4.3, and 2.4.9).

**6.3.2 Occurrence of Bubbles and Pinholes:** Generally, the self-curing inorganic zinc primers have a greater tendency to cause bubbling or pinholing in the topcoat than post-curing inorganic or organic zinc-rich primers. High build coatings especially formulated for application over zinc-rich coatings can reduce bubbling and other application problems. Low build coatings—especially gloss or semi-gloss coatings—have a greater tendency for bubbling or pinholing. Generally, the greater the thickness of the zinc-rich primer, the greater the tendency for bubbles and pinholes to form in the topcoat. Post-cured inorganic zinc primers show less tendency for application bubbling and pinholing in the topcoat as compared to typical solvent-borne self-curing inorganic zinc primers.

**6.3.3 Repair of Bubbles and Pinholes:** Bubbles, pinholes, or craters are unsightly and should be avoided using the methods in 6.4. They can be repaired by sanding the affected areas, followed by reapplication of the topcoat. When properly repaired, they do not affect the performance of the system. If left unrepaired, the performance may be affected if the environment is characterized by aggressive chemical fumes or chemical contaminants, combined with high humidity and condensed moisture.

**6.4 MINIMIZING BUBBLING AND PINHOLING:**

**6.4.1** Some manufacturers recommend the application of a thin mist coat of the topcoat to reduce bubbles, pinholes, and craters, while others recommend a thinned coat of the topcoat. Both are followed by a full wet coat of the topcoat. The application of the topcoat in two coats (a mid coat/full coat or a thinned coat/full coat) rather than a single heavy coat, will reduce the chance of surface defects, such as pinholes and bubbles.

**6.4.2** Other manufacturers recommend using a tie coat, such as vinyl wash primer (SSPCPaint 27) to condition the substrate. The acid component of the wash primer reacts with the zinc and allows the wash primer to bond to the zinc-rich primer. This may be followed by a topcoat of any compatible type. Other specially formulated tie coats may also be used to promote adhesion for topcoats.

**6.5 ADHESION OF TOPCOATED SYSTEMS:** Three common methods of measuring adhesion of topcoated zinc-rich primer systems have been identified. However, no consensus for minimally acceptable adhesion ratings could be established for any of these methods. The user should consult the coatings manufacturer regarding appropriateness and interpretation of adhesion test results. The three methods for measuring adhesion are:

**6.5.1 X-Cut Tape Test (ASTM D 3359 - Method A):** An X-cut is made in the film to the substrate, pressure sensitive tape is applied over the cut, and then removed. Adhesion is assessed quantitatively on a scale of 0 to 5 by comparison with descriptions.

**6.5.2 Cross Cut Tape Test (ASTM D 3359 - Method B):** A lattice pattern with either 6 or 11 cuts in each direction is made in the film to the substrate; pressure sensitive tape is applied over this area and then removed. Adhesion is assessed by comparison with descriptions and illustrations on a scale of 0 to 5. There shall be no separation of the paint film or delamination of an entire square. Spalling, loss of adhesion around the perimeter due to cutting of each square, is acceptable. This method is NOT recommended for film thicknesses greater than 125 micrometers (5 mils).

**6.5.3 Portable Adhesion Testers (ASTM D 4541):** A dolly is glued to the coating surface, then pulled off. The force required to remove the dolly, as well as the nature of the disbonding, are evaluated. This test provides a quantitative measure of the pull-off strength, but reproducibility of this method and the significance of the adhesion values have yet to be established.

**6.6 TOUCH-UP AND REPAIR OF TOPCOATED ZINC-RICH PRIMER:** Touch-up and repair of topcoated zinc-rich primers may be required when the topcoat is damaged, when areas intended to be topcoated are missed, or when the total dry film thickness is insufficient. The methods of touch-up and repair depend upon the specific generic type of the topcoat (e.g., epoxy, vinyl, or urethane) and the time interval between the original topcoating and the touch-up and repair operation. The new coating should be applied to provide uniform appearance with the existing coating, including feathering of edges. The surface may require cleaning by solvent, detergent, or pressurized water to remove dirt, grease, and other surface contaminants. Two-component, chemically-curing topcoats may require mechanical abrading to provide adequate surface roughness, even when reapplied over the same generic type of coating. The topcoat manufacturer should be consulted for the procedures for specific coatings.

Provided by : www.spic.ir Licensee: NISOC Library

## 7. Notes

**7.1** Although all of the generic coating types listed in Table 1 have been successfully applied as topcoats over zinc-rich primers, combining different manufacturers' formulations may adversely affect coating performance. No coating should be applied to a zinc-rich primer unless recommended by the manufacturer for that purpose. It is good painting practice to use primer, intermediate coat (if any), and topcoat produced by the same manufacturer.

**7.2** Other factors that may influence selection of topcoat and primer-topcoat combinations are: specific durability of topcoats in intended exposure environments, appearance of the finished coat, recoatability, heat resistance, and cost. Information on these factors may be found in SSPC Painting Manual, Volume 1, Good Painting Practice, as well as other technical publications, and from coatings manufacturers. The general appearance of a properly applied zinc-rich topcoated system is acceptable for typical industrial applications; however, an appearance as smooth as an automotive finish coat should not be expected.

**7.3** To achieve satisfactory results when topcoating post-cured inorganic zinc primers, it is important that the cure residue be cleaned from the surface before applying topcoats. Normally, this is done by water washing, using a stiff bristle brush for stubborn residues.

**7.4** Topcoated zinc-rich primers should not be used for immersion service unless specifically recommended by the manufacturer.

**7.5** Because of possible delamination and zinc splitting when topcoating an undercured inorganic zinc, this procedure should only be used in accordance with the manufacturer's recommendations.

**7.6** Certain topcoats have a high sensitivity to moisture. For example, amine-cured epoxy coatings may show large blisters if any moisture remains in the pores of the zinc primer at the time of topcoat application.

**7.7** SSPC specification (SSPC-Paint 29, "Zinc Dust Sacrificial Primer, Performance-Based") describes a primer with zinc dust loading in the dry film down to 50 percent. SSPC field tests have shown that the practical lower limit for zinc loading is 65 percent. These reduced loading primers may use varying amounts of non-zinc pigment to replace some or all of the zinc dust. These coatings often have topcoating properties comparable to paints meeting the requirements of SSPC-Paint 20, "Zinc-Rich Primers Type I—Inorganic & Type 11—Organic."

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This guide does not attempt to address problems concerning safety associated with its use. The user of this guide, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

* This paint contains chromate pigments. Users are urged to follow all health, safety, and environmental requirements in applying, handling or disposing of these materials.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 9.01
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 9.01

## Cold-Applied Asphalt Mastic Painting System with Extra-Thick Film

### 1. Scope

**1.1** This specification covers a cold-applied asphalt mastic painting system for above-ground steel structures.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zones 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 3B (chemical, neutral), and 3C (chemical, alkaline). It should not be used in contact with oils, solvents, or other reagents which tend to soften or attack the coating.

### 2. Description

**2.1** This painting system consists of surface preparation by commercial blast cleaning or pickling and one thick or two thin coats of cold-applied asphalt mastic.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 12** | Cold Applied Asphalt Mastic (Extra Thick Film) |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1** SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents better degrees of cleaning shall be substituted (SSPC-SP 5, "White Metal Blast Cleaning," or SSPC-SP 10, "Near-White Blast Cleaning").

### 5. Paints

**5.1 COATING:** SSPC-Paint 12, "Cold-Applied Asphalt Mastic (Extra Thick Film)."

### 6. Paint Application

**6.1 PAINT APPLICATION:** Follow the requirements SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and in particular with the section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** This specification applies to maintenance painting, provided specific instructions are included on the degree and amount of solvent cleaning, spot cleaning, spot priming, priming, and finish painting. For additional information on maintenance painting procedures, see SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems."

**6.4 NUMBER OF COATS:** Minimum of one.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC- PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": 1600 micrometers (63 mils).

### 7. Inspection

**7.1** All work and materials supplied under this specification are 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

Provided by : www.spic.ir Licensee: NISOC Library

under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 10.01
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 10.01

## Hot-Applied Coal Tar Enamel Painting System

### 1. Scope

**1.1** This specification covers a hot-applied coal tar painting system for underground and underwater steel structures, consisting of a primer and two hot-applied coats.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zones 2C (fresh water immersion), 3B (chemical, neutral), and 3C (chemical, alkaline). It has good abrasion resistance. It is also suitable for underground use. It must be used with discretion for immersion in corrosive chemicals since the coating is dissolved by some organic solvents and attacked by oxidizing solutions.

**1.3** The coal tar enamel must be topcoated with coal tar emulsion when exposed to sunlight to prevent checking and alligatoring.

### 2. Description

**2.1** This painting system consists of surface preparation by commercial blast cleaning or pickling, one prime coat, and two finish coats of hot-applied coal tar enamel per AWWA C 203, "Standard Specifications for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape—Hot Applied." A final topcoat of coal tar emulsion is to be applied when exposed to sunlight. The AWWA enamel is recommended for potable water.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 through 3.7 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 32** | Coal Tar Emulsion Coating |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 AMERICAN WATER WORKS ASSOCIATION (AWWA) SPECIFICATION:**

| | |
|---|---|
| **C 203** | Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape— Hot-Applied |

**3.7 FEDERAL STANDARDS AND SPECIFICATIONS:**

| | |
|---|---|
| **MIL-C-15203** | (canceled) Coating Compound, Bituminous, Emulsion Type, Coal Tar Base [See SSPC-Paint 32.] |

### 4. Surface Preparation

**4.1** SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents, better degrees of cleaning shall be substituted (SSPC-SP 5, "White Metal Blast Cleaning," or SSPC-SP 10, "Near-White Blast Cleaning").

### 5. Paints

**5.1 PRIMER:** Primer complying with specification AWWA C 203, "Standard Specifications for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape—Hot-Applied."

**5.2 SECOND COAT:** Second coat complying with specification AWWA C 203, "Standard Specifications for Coal Tar Protective Coatings and Linings for Steel Water Pipelines— Enamel and Tape—Hot Applied."

Provided by : www.spic.ir Licensee: NISOC Library

**5.3 THIRD COAT:** The third coat shall be the same coating as the second coat.

**5.4 FOURTH COAT (when required):** All surfaces that are to be exposed to sunlight shall be given a fourth coat consisting of MIL-C-15203, "Coating Compound, Bituminous, Emulsion Type, Coal-Tar Base." This coat shall be applied no sooner than two weeks after the third coat is applied. [MIL-C-15203 has been canceled; see SSPC-Paint 32.]

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow the requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and, where applicable, AWWA C 203, "Standard Specifications for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape—Hot-Applied."

**6.2 TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and in particular with the section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** For maintenance painting procedures, see SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems."

**6.4 NUMBER OF COATS:** Minimum of three.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 13 to 50 micrometers (0.5-2.0 mils); second coat 760 micrometers (30 mils); finish coat 760 micrometers (30 mils); for the three-coat painting system 1575 micrometers (62 mils); fourth coat (when required) 250 micrometers (10 mils); for the four-coat system 1830 micrometers (72 mils).

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**9.2** If an electrical inspection is required, use a 7,200 volt holiday detector of an approved type.

**9.3** Hot enamels are applied at temperatures ranging from 220 to 260°C (425 to 500°F), and extreme care must be used when melting and handling.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 10.02
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 10.02

## Cold-Applied Coal Tar Mastic Painting System

### 1. Scope

**1.1** This specification covers a cold-applied coal tar painting system for underground and underwater steel structures, consisting of two cold-applied coats.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zones 2C (fresh water immersion), 3B (chemical, neutral), and 3C (chemical, alkaline). It has fairly good abrasion resistance and is suitable for underground use. It must be used with discretion for immersion in corrosive chemicals since the coating is dissolved by some organic solvents and attacked by oxidizing solutions.

**1.3** The coal tar mastic must be topcoated with coal tar emulsion when exposed to sunlight to prevent checking and alligatoring.

### 2. Description

**2.1** This painting system consists of surface preparation by commercial blast cleaning or pickling and two coats of cold-applied coal tar mastic. This paint is self-priming and does not require a separate prime coat. A final topcoat of coal tar emulsion is to be applied when exposed to sunlight. This system is not recommended for potable water or high temperatures.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 12** | Cold Applied Asphalt Mastic (Extra Thick Film) |
| **Paint 32** | Coal Tar Emulsion Coating |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.7 FEDERAL STANDARDS AND SPECIFICATIONS:**

| | |
|---|---|
| **MIL-C-15203** | (canceled) Coating Compound, Bituminous, Emulsion Type, Coal Tar Base [See SSPC-Paint 32.] |
| **MIL-C-18480** | Coating Compound, Bituminous, Solvent, Coal Tar Base |

### 4. Surface Preparation

**4.1** SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents better degrees of cleaning shall be substituted (SSPC-SP 5, "White Metal Blast Cleaning," or SSPC-SP 10, "Near-White Blast Cleaning").

### 5. Paints

**5.1 PRIMER:** MIL-C-18480, "Coating Compound, Bituminous, Solvent, Coal Tar Base."

**5.2 SECOND COAT:** The second coat shall be the same coating as the first coat.

**5.3 THIRD COAT (when required):** All surfaces that are to be exposed to sunlight shall be given a third coat consisting of MIL-C-15203, "Coating Compound, Bituminous, Emulsion Type, Coal Tar Base." This coat shall be applied no sooner than two weeks after the second coat is applied.

Provided by : www.spic.ir Licensee: NISOC Library

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow the requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 TOUCH-UP PAINTING:** In accordance with specifications SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and in particular with the section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** This specification applies to maintenance painting, provided specific instructions are included on the degree and amount of solvent cleaning, spot cleaning, spot priming, priming, and finish painting. For additional information on maintenance painting procedures, see SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems."

**6.4 NUMBER OF COATS:** Minimum of two.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 380 micrometers (15 mils); second coat 250 micrometers (10 mils); for the two-coat painting system 635 micrometers (25 mils); third coat (when required) 250 micrometers (10 mils); for the three-coat system 890 micrometers (35 mils).

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**9.2** If an electrical inspection is required, use a holiday detector of the Tinker-Raser, Bird Dog, or other approved type having a range of 67.5 to 75 volts.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 11.01
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 11.01

## Black (or Dark Red) Coal Tar Epoxy Polyamide Painting System

### 1. Scope

**1.1** This specification covers a complete coal tar epoxy polyamide black (or dark red) painting system for the protection of steel surfaces that will be exposed to severely corrosive conditions.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zones 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 2C (fresh water immersion), 2D (salt water immersion), 3A (chemical, acidic), 3B (chemical, neutral), and 3C (chemical, alkaline). Its resistance to chemical fumes, mists, and splashings is generally considered to be good, but its suitability for prolonged immersion in specific chemicals should be confirmed by trial tests in the absence of applicable case histories. It is also suitable for underground exposure and as a protective coating for sound concrete surfaces in marine and some chemical environments.

**1.3** Its good weathering properties can be improved by applying a finish coat of a compatible aluminum pigmented paint.

**1.4** Although it is self-priming and exhibits good adhesion to clean structural steel surfaces, it may also be used over suitable inhibitive primers.

**1.5** The color of paint is black unless red is specified.

### 2. Description

**2.1** This painting system consists of surface preparation by commercial blast cleaning and two or more coats, if necessary, of coal tar epoxy polyamide paint.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 through 3.6 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 16** | Coal Tar Epoxy Polyamide Black (or Dark Red) Paint |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL STANDARDS AND SPECIFICATIONS:**

| | |
|---|---|
| **MIL-PRF-23236** | Paint Coating Systems, Fuel and Salt Water Ballast Tanks (Formerly DoD-P-23236 or MIL-P-23236) |

### 4. Surface Preparation

**4.1** SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents better degrees of cleaning shall be substituted (SSPC-SP 5, "White Metal Blast Cleaning," or SSPC-SP 10, "Near-White Blast Cleaning").

### 5. Paints

**5.1 FIRST COAT:** SSPC-Paint 16, "Coal Tar Epoxy Polyamide Black (or Dark Red) Paint."

**5.2 SECOND COAT:** The second coat shall be the same coating as the first coat.

Provided by : www.spic.ir Licensee: NISOC Library

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.1.1** When the substrate or an applied coat is subject to exposure to sunlight and is expected to have surface temperatures above 52°C (125°F), either the surfaces shall be shaded by overhead cover or the intercoat drying time shall be adjusted downward as may be necessary to avoid poor intercoat adhesion.

**6.1.2 Final Drying Time:** The completed painting system shall be allowed to cure for at least the length of time shown below before being exposed to water, solvents, or chemicals in the form of condensation, mists, splashing, or immersion.

| Average Ambient Temperature | | Days Curing |
|---|---|---|
| Degrees F | Degrees C | |
| 70 or over | 21 or over | 5 |
| 60 to 70 | 16 to 21 | 7 |
| 50 to 60 | 10 to 16 | 10 |

**6.2 TOUCH-UP PAINTING:** In accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel" and in particular with section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** For maintenance painting procedures, see SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems."

**6.4 NUMBER OF COATS:** Minimum of two.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": first coat 200 micrometers (8 mils); 200 micrometers (8 mils); for the two-coat painting system 400 micrometers (16 mils).

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**9.2** The specification can also be applied to the coating of concrete surfaces provided specific provisions are included in the procurement documents regarding cleaning and preparation of the surfaces and the thickness of the material per coat.

**9.3** While this specification applies primarily to a coal tar epoxy paint which is cured with a co-reacting polyamide resin and polyamide catalyst, most of its provisions are also appropriate for coal tar epoxy materials, cured solely by polyamines, commercially available from many suppliers. Such materials or materials conforming to MIL-PRF-23236 may, however, be substituted only by express permission.

**9.4** If an electrical inspection is required, use a holiday detector of the Tinker-Raser, Bird Dog, or other approved type having a range of 67.5 to 75 volts.

**9.5** Coal tar epoxy coatings may be toxic and irritating to the skin and eyes.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS Guide 12.00
September 1, 1994
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM GUIDE NO. 12.00

## Guide to Zinc-Rich Coating Systems

### 1. Scope

**1.1** This guide provides general information on the description, selection and application of zinc-rich coatings, and the selection of topcoats.

**1.2** Zinc-rich coatings are highly pigmented primer coatings that are uniquely defined by their capability of galvanically protecting steel exposed at discontinuities such as narrow scratches and holidays. While the major pigment component in a zinc-rich coating is zinc dust, the vehicle may be inorganic or organic.

**1.3** Zinc-rich coatings are classified as follows:

**Type IA**—Inorganic - post-cured, water-borne, alkali-silicates
**Type IB**—Inorganic - self-cured, water-borne, alkali silicates
**Type IC**—Inorganic - self-cured, solvent-borne, alkyl silicates
**Type IIA**—Organic - thermoplastic binders
**Type IIB**—Organic - thermoset binders

**1.4** Certain zinc-rich coating systems are suitable for use in protecting steel surfaces either topcoated or untopcoated. Zinc-rich systems are not suitable for certain exposure conditions. (See Section 4 and Table 1.)

### 2. Description

**2.1 GENERAL USAGE:**

**2.1.1** Zinc-rich coatings are primarily formulated to provide protection to steel by virtue of the galvanic protection provided by the zinc. They also typically provide hard, abrasion-resistant coatings, but flexibility and impact resistance may vary widely. These coatings normally require a blast cleaned surface for best results, and are usually applied in one coat 50 to 125 micrometers (2 to 5 mils) dry film thickness over the cleaned steel.

**2.1.2** Some are used as prefabrication primers or shop primers, where they are applied to freshly blast cleaned steel plates and sections. The prefabrication primers, often at a lesser thickness, are intended to protect the steel throughout the fabrication period until the final painting system can be applied to the finished structure. At that juncture, the pre-fabrication primer may be incorporated into the final system or removed. SSPC-PS Guide 22 and SSPC-Paint 30 discuss the use of zinc-rich coatings as prefabrication primers.

**2.2 VEHICLES FOR ZINC-RICH COATINGS:** Zinc-rich coatings are available as a number of different commercial types. These coatings may be categorized as having inorganic (Type I) or organic (Type II) vehicles.

**2.2.1 Inorganic Vehicles:** Type I inorganic vehicles include post-cured waterborne alkali silicates (IA); self-cured, waterborne alkali silicates (IB); and self-cured, solvent-borne alkyl silicates (IC). The vehicles of Types IA and IB may include the alkali earth silicates (commonly sodium, lithium, potassium, and ammonium silicate), while IC vehicles are alkyl silicates (most commonly ethyl silicates). Type IA vehicles are post-cured with a separate wash solution, usually mildly acidic in nature, applied as an aftercoat. Type IB vehicles are chemically similar to Type IA vehicles, except they are formulated to self-cure upon exposure to moisture and carbon dioxide in the air. Type IC vehicles self-cure upon exposure to atmospheric moisture.

**2.2.2 Organic Vehicles:** Type II vehicles include those with thermoplastic binders (IIA) and thermoset binders (IIB). Type II thermoplastic vehicles include polymers of chlorinated rubber, styrene, vinyl, and other organic materials that soften upon exposure to heat. Type IIB thermoset vehicles do not soften upon heating, and include polymers of epoxy, polyurethane, polyester, silicone, and other chemically cross-linked materials.

**2.3 PIGMENTATION FOR ZINC-RICH COATINGS:** The major pigment component in these coatings is zinc dust of the type described in ASTM D 520. Inorganic zinc-rich coatings contain a minimum zinc dust content of 74 percent by weight in the dry film. Organic zinc-rich coatings contain a minimum zinc dust content of 77 percent by weight in the dry film.

**2.4 NUMBER OF COMPONENTS:** Inorganic and organic zinc-rich coatings are supplied as a single package or multi-component package. Many multi-component packages have the zinc pigment packaged separately to be mixed with the vehicle at the time of application. All multi-component coatings have a limited pot life after mixing.

Provided by : www.spic.ir Licensee: NISOC Library

## 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.3 and 3.4.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **Guide 9** | Guide for Atmospheric Testing of Coatings in the Field |
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness with Magnetic Gages |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |
| **Paint 20** | Zinc-Rich Primers (Type I - Inorganic and Type II - Organic) |
| **Paint 29** | Zinc Dust Sacrificial Primer, Performance-Based |
| **Paint 30** | Weld-Through Inorganic Zinc Primer |
| **PS 12.01** | One Coat Zinc-Rich Painting System |
| **PS Guide 8.00** | Guide to Topcoating Zinc-Rich Primers |
| **PS Guide 22.00** | Guide for Selecting One-Coat Preconstruction or Prefabrication Painting Systems |

**3.4 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 520** | Specification for Zinc Dust Pigment |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

## 4. Selection of Coating System

**4.1 CLASSIFYING EXPOSURE ZONES:** Successful corrosion protection utilizing a zinc-rich coating system is dependent upon the anticipated service in environmental exposure zones. Guidelines for the use of organic and inorganic zinc-rich coatings, either topcoated or untopcoated, are presented below based on the following SSPC classifications of exposure:

| | |
|---|---|
| 1A | Interior, Normally Dry |
| 1B | Exterior, Normally Dry |
| 2A | Frequently Wet—Fresh Water |
| 2B | Frequently Wet—Salt Water |
| 2C | Fresh Water Immersion |
| 2D | Salt Water Immersion |
| 3A | Atmospheric Chemical Exposures (pH 2 to 5) |
| 3B | Atmospheric Chemical Exposures (pH 5 to 10) |
| 3C | Atmospheric Chemical Exposures (pH 10 to 12) |
| 3D | Chemical Exposure, Solvents |
| 3E | Chemical Exposure, Severe |

**4.2 GUIDELINES FOR USAGE:** The untopcoated and topcoated inorganic and organic zinc-rich coatings are categorized as suitable (recommended), unsuitable (not recommended) or questionable for the exposure environments in Section 4.1. Questionable means that some products may perform satisfactorily, while other products may not, or that the environmental description is too variable to assure satisfactory coating system performance. Guidelines for the use of topcoated and untopcoated zinc-rich primers in various environments are presented below and in Table 1.

**4.3 USE OF UNTOPCOATED ZINC-RICH COATINGS:**

**4.3.1 Untopcoated Inorganic Zinc-Rich Coatings:** These coatings may be suitable for use in the following environmental zones: 1A, 1B, 2A, 2B, 3B, and 3D. These coatings are not recommended for the following environmental zones: 3A, 3C, 3E. These coatings are questionable for environmental zones 2C and 2D.

**4.3.2 Untopcoated Organic Zinc-Rich Coatings:** These coatings may be suitable for use in the following environmental zones: 1A, 1B, 2A, and 3B. These coatings are not recommended for the following environmental zones: 2B, 2D, 3A, 3C, 3D, and 3E. These coatings are questionable for environmental zone 2C.

**4.4 USE OF TOPCOATED ZINC-RICH COATING SYSTEMS:**

**4.4.1 Topcoated Inorganic Zinc-Rich Coating Systems:** These systems may be suitable for the following environmental zones: 1A, 1B, 2A, 2B, 3B, and 3C. These systems are not recommended for environmental zone 3E. These systems are questionable for the following environmental zones: 2C, 2D, and 3D.

Provided by : www.spic.ir Licensee: NISOC Library

**4.4.2 Topcoated Organic Zinc-Rich Coating Systems:** These systems may be suitable for the following environmental zones: 1A, 1B, 2A, 2B, 3B, and 3C. These systems are not recommended for environmental zone 3E. These systems are questionable for the following environmental zones: 2C,2D, 3A, 3D.

**4.5** These guidelines are based on the general characteristics of the different types of zinc-rich coating systems and exposure environments. Substantial formulation differences exist among zinc-rich coatings. The ability of a topcoated system to perform adequately is strongly dependent on the generic type and formulation of the topcoat. (See Section 6.3.) Therefore, the recommendations of the coating manufacturer regarding the use of a zinc- rich coating (organic or inorganic, topcoated or untopcoated) in a given environment should be solicited. This is particularly critical when considering use of a zincrich system in a questionable category of Sections 4.3.1, 4.3.2, 4.4.1, 4.4.2 and Table 1.

## 5. Surface Preparation

**5.1 DEGREE OF CLEANING:** Although blast cleaning to SSPC-SP 5 may be preferred, it is also the most costly; in most cases a near-white metal blast (SSPC-SP 10) or in some cases even a commercial (SSPC-SP 6) blast may provide a satisfactory surface for these coatings. Table 1 provides minimum surface preparation guidelines for zinc-rich coating systems in various environments. Although this specification is written for blast cleaned surfaces, under certain conditions pickling can be used as a surface preparation for zinc-rich primers if agreed upon by the contracting parties. The pickling procedures shall be in accordance with SSPC-SP 8, “Pickling”, paragraph 5.2.1. Specifically, this requires adequate rinsing of all pickling residues with 60°C (140°F) hot water, and prohibits subsequent phosphoric acid or dichromate treatment.

**5.2 SURFACE PROFILE:** Surface profile should be in the range of 25 to 90 micrometers (1.0 to 3.5 mils) unless otherwise recommended by the coating manufacturer.

## 6. Coating Materials

**6.1 PRIMER:** SSPC-Paint 20, Zinc-Rich Primers (Type I-"Inorganic" and Type II-"Organic".)

**6.1.1** Zinc-rich coatings are particularly useful for protecting steel surfaces in moist corrosive environments. These primers are very resistant to high humidity and salt air, lasting many years. They galvanically prevent rust undercutting at small breaks in the coating system, often filling the breaks with protective deposits of zinc oxidation products, greatly extending coating life. Unless topcoated, they are unsuitable for acidic or alkaline service outside the pH range from about 5 to 10. Variations in properties of these coatings depends largely on the vehicle, whether inorganic or organic. The choice of best coating for a specific end use must be made by a comparison of properties with the requirements of the service. Application and surface preparation constraints may limit the choice. The degree of corrosion protection desired may be a prime consideration. Zinc-rich coatings are characterized by their abrasion resistance, toughness of film, and galvanic action of the zinc. In wet conditions above 60°C (140°F), zinc-rich primers are not recommended, due to rapid depletion of zinc.

**6.1.2 Inorganic:** Inorganic zincs, while requiring more care in surface preparation and application compared to organic zincs, have a greater ability to withstand exposure to most solvents, oils, and neutral petroleum products. Some types of inorganic zincs require moisture to cure. Inorganic zincs have a tendency to mudcrack at heavier thicknesses, and dry spray may occur under certain ambient conditions. They function well up to 400°C (750°F) in dry conditions. In wet conditions, zincrich primers function well up to 50°C (120°F). Within the range of 50° to 60°C (120° to 140°F), performance depends upon formulation and the coating manufacturer should be consulted. Compared to organic zincs, inorganic zinc-rich primers generally exhibit more pinholing and bubbling upon topcoating. The minimum zinc loading is 74 percent by weight of zinc in dry film.

**6.1.3 Organic:** Compared with the inorganic type, the organic zinc primers are generally more tolerant of surface preparation and are easier to topcoat. This type generally does not require moisture to cure, has less tendency to mudcrack, and has less tendency to dry spray. Organic zincs generally provide less resistance to abrasion, solvents, and high temperatures than the inorganics. When left untopcoated, organic zincs may provide less galvanic protection than untopcoated inorganic zincs. This type combines the properties of the organic vehicle with the abrasion resistance and the galvanic action of the zinc pigment. The minimum zinc loading is 77 percent by weight of zinc in dry film.

**6.2 ALTERNATE PRIMER:** SSPC-Paint 29, “Zinc Dust Sacrificial Primer Performance-Based.”

**6.2.1** SSPC-Paint 29 is a zinc dust containing primer specification which requires a minimum zinc loading of 50% by weight of dry film rather than the higher loading required by SSPC-Paint 20. SSPC field tests have shown that the practical lower limit for zinc loading is 65 percent.

**6.2.2** For Paint 29, the galvanic protection and long-term corrosion resistance are assured by more rigorous performance tests than those required in Paint 20. These include exterior fence tests as well as conventional labora-

Provided by : www.spic.ir Licensee: NISOC Library

tory accelerated testing. Paint 29 establishes three levels of performance. Level 1 is laboratory testing only. Level 2 is a 12 month fence test, and Level 3 is a 30 month fence test. Level 2 may be used as an interim qualification to allow for earlier procurement of the coating.

**6.3 TOPCOATS:** Suitable topcoating of the zinc-rich primer may provide additional service life. Topcoats must be formulated not only for environmental resistance, but also for suitable application (to minimize pinholing, bubbling, etc.) over a zinc-rich primer. SSPC Guide 8.00, "Guide to Topcoating Zinc-Rich Primers," discusses topcoating of zinc-rich primers.

Table 1 provides guidelines for topcoating zinc-rich primers in various environments.

## 7. Coating Application

**7.1 APPLICATION GUIDELINES:** Follow requirements of SSPC-PA 1 for general application guidelines. For application of the zinc-rich, follow requirements of SSPC-PS 12.01; for the topcoat(s) follow SSPC-PS Guide 8.00.

**7.2 APPLICATION OF ZINC RICH COATINGS:** Zinc-rich coatings vary in application characteristics, depending upon climatic conditions at the time of application. High substrate or ambient temperatures may result in a "dry spray" or porous coating, particularly with inorganic zinc. On windy days, "overspray" may be a problem. Many zinc-rich coatings will not dry or cure properly at extremes of high or low humidity (in excess of 90% or less than 50% relative humidity). All zincrich coatings are preferably applied by spray, but may be brushed for small jobs, or to fill in irregularities. All zinc-rich materials may settle, and care should be taken to ensure they are thoroughly mixed before and during application. Brushing should be done with extreme caution to avoid zinc settlement. Exercise caution during work stoppages to prevent settling of zinc in hoses and equipment.

**7.3 FILM THICKNESS:** Due to the galvanic action of the zinc, these coatings can give satisfactory performance under mildly corrosive conditions with one coat application as little as 50 micrometers (2 mils) thick. The film thickness should be measured in accordance with SSPC-PA 2.

**7.4 APPLICATION OF TOPCOAT:** Most of the coatings can be topcoated for improved performance under more severe exposures. Special precautions in cleaning the prime coat prior to topcoating may be required, especially in moderate or severe chemical exposures. When self-coating inorganic zinc-rich coatings, solicit the manufacturer's instructions. Often, organic zinc-rich coatings or non-zinc-rich coatings are used in lieu of self-coating an inorganic zinc-rich primer. (See SSPC-PS Guide 8.00 for additional information.)

## 8. Submittals

**8.1 COATING HISTORY:** Documented information with authenticated data detailing the past history and exposure of the coating in terms of service life under specific conditions should be required when preparing specifications for major projects. Details relative to surface preparation and application of coating shall be supplied. SSPC-Guide 9 lists the type of data to be submitted.

**8.2 COATING CHARACTERISTICS:** Sufficient identifiable characteristics other than trade or brand name or designated number or symbol should be provided to permit laboratory test verification of coating identity. These characteristics should include formulation information readily derivable in a laboratory, including the generic nature of the vehicle, pigment, and volatile portions, the weight per gallon, the percent solids by volume or coverage rate, and other procedures used for quality control during manufacture of the coating.

**8.3 TOPCOAT SUBMITTALS:** When a tie coat or topcoat is specified, a similar coating history should be required for the entire system as described in Section 8.1. Details relevant to the surface preparation, zinc-rich primer, and subsequent topcoat(s) should be required, along with information regarding the performance or suitability of the system for corrosion protection in the intended environment. (See SSPC-Guide 9.)

**8.4 MANUFACTURER'S LITERATURE:** This guide is intended to be supplemented by the coating manufacturer's instructions and literature. If the manufacturer's literature or recommendations are to become part of the requirements of a procurement document, they must be submitted as part of the design, or bidding document. The date of the manufacturer's literature and the number of sheets should be listed. In the event of a conflict between the manufacturer's written instructions and this guide, the specifier, or other appropriate authorities, should be notified to provide clarification.

## 9. Inspection

**9.1** All work and materials supplied under this specification is 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. (See Note 11.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**9.2** Samples of paints under this painting system may

Provided by : www.spic.ir Licensee: NISOC Library

be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**9.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 10. Disclaimer

**10.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**10.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 11. Notes

Notes are not a requirement of this specification.

**11.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**11.2 QUALITY ASSURANCE:** The user should ensure that coatings qualified according to SSPC-Paint 20, Zinc-Rich Primers (Type I-"Inorganic" and Type II-"Organic"), or other test methods or procedures will not be different from those actually applied at the jobsite. This assurance can be obtained for vehicle components by obtaining infrared spectrographic curves from the laboratory test sample and comparing them with curves obtained from IR spectra on selected field samples. Pigment components may be similarly compared using atomic absorption or other spectrographic analyses. If there are any significant differences between the spectra obtained from the laboratory and field coating samples, the coating manufacturer should be consulted. Physical tests, such as weight/gallon, viscosity, solids by weight, etc., can also assure quality. If differences occur beyond the coating manufacturer's published tolerance or 15%, the manufacturer should be consulted.

**11.3** The degree of deviation from the ideal surface preparation which zinc-rich coatings will tolerate without serious loss of their properties varies considerably from coating to coating. Therefore, adequate instructions from the manufacturer are essential and must be closely followed to ensure maximum performance.

**11.4 VOC CONTENT:** Each coating, after recommended thinning, must conform to published government regulations regarding volatile organic compound (VOC) content. VOC information should be supplied on the label or the technical data sheet. Various governmental agencies may have different VOC limits or use different methods of testing. The owner may modify this specification as necessary to specify a particular VOC content limit consistent with local regulations. Coatings meeting the composition and performance requirements of this specification usually have a VOC level between 0 and 500 g/L (0 and 4.2 lb/gal).

Provided by : www.spic.ir Licensee: NISOC Library

## TABLE 1
## Guidelines for Surface Preparation and Topcoating of Zinc-Rich Primers in Various Environments

Note: This table provides general guidelines only. Its use should be limited to determination of generic suitability and minimum surface preparation requirements. There are substantial differences in performance between the various types of zinc-rich coatings in a given environment. These recommendations provide minimum acceptable surface preparation, primer, and topcoating requirements for the designated environmental zones. However, recommendations do not imply equivalent system performance. For specific conditions, the coating manufacturer should be consulted.

### ZINC-RICH BINDER TYPES

| Environmental Zones | | IA | | IB | | IC | | IIA | | IIB | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Untopcoated | Topcoated | Untopcoated | Topcoated | Untopcoated | Topcoated | Untopcoated | Topcoated | Untopcoated | Topcoated |
| 1A | Interior, Normally Dry | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 6 | R-SP 6 | R-SP 6 | R-SP 6 | R-SP 6 | R-SP 6 |
| 1B | Exterior, Normally Dry | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 6 | R-SP 6 | R-SP 6 | R-SP 6 | R-SP 6 | R-SP 6 |
| 2A | Frequently Wet, Fresh Water | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 10 |
| 2B | Frequently Wet, Salt Water | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 10 | NR | R-SP 10 | NR | R-SP 10 |
| 2C | Fresh Water Immersion | Q-SP 5 | Q-SP 5 | Q-SP 5 | Q-SP 5 | Q-SP 10 | Q-SP 10 | NR | Q-SP 10 | Q-SP 10 | Q-SP 10 |
| 2D | Salt Water Immersion | Q-SP 10 | Q-SP 10 | Q-SP 10 | Q-SP 10 | Q-SP 10 | Q-SP 10 | NR | Q-SP 10 | NR | Q-SP 10 |
| 3A | Chemical Exposure, Acidic (pH 2 to 5) | NR | Q-SP 10 | NR | Q-SP 10 | NR | Q-SP 10 | NR | Q-SP 6 | NR | Q-SP 6 |
| 3B | Chemical Exposure, Neutral (pH 5 to 10) | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 10 | R-SP 6 | R-SP 6 | R-SP 6 | R-SP 6 | R-SP 6 | R-SP 6 |
| 3C | Chemical Exposure, Alkaline (pH 10 to 12) | NR | R-SP 10 | NR | R-SP 10 | NR | R-SP 6 | NR | R-SP 6 | NR | R-SP 6 |
| 3D | Chemical Exposure, Solvent | R-SP 10 | Q-SP 10 | R-SP 10 | Q-SP 10 | R-SP 6 | Q-SP 6 | NR | NR | NR | Q-SP 6 |
| 3E | Chemical Exposure, Severe | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR |

**BINDER TYPES:**
IA = Inorganic; post-cured, waterborne alkali silicates
IB = Inorganic; self-cured, waterborne alkali silicates
IC = Inorganic; self-cured, solvent-borne alkyl silicates
IIA = Organic; thermoplastic binders (e.g., phenoxy)
IIB = Organic; thermoset binders (e.g., epoxy polyamide, moisture-cured polyurethane)
**RECOMMENDED USAGE:**
R = Recommended
NR = Not Recommended
Q = Some products recommended, others not recommended. (See Sections 4.2, 4.3, 4.4, and 4.5.)
**RECOMMENDED SURFACE PREPARATION:**
The number refers to the minimum SSPC blast cleaning surface preparations as follows:
SP 5 = SSPC-SP 5, White Metal Blast Cleaning
SP 6 = SSPC-SP 6, Commercial Blast Cleaning
SP 10 = SSPC-SP 10, Near-White Blast Cleaning
NOTE: For pitted old steel, the blast cleaning requirement should be the next higher degree of cleanliness, i.e., the SP 10 shown above should be SP 5, the SP 6 shown above should be SP 10.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 12.01
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 12.01

## One-Coat Zinc-Rich Painting System

### 1. Scope

**1.1** This specification covers a one-coat zinc-rich painting system to be used on steel in mild to moderately severe environments.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zone 3B (chemical, neutral). It is not recommended for environments where corrosive contaminants will have a pH below 5 or above 9 or severely corrosive environments. The system is recommended as a durable shop primer or as a protective one-coat system for normal atmospheric weathering environments and certain immersion services.

**1.3** This specification does not pertain to weldable prefabrication zinc-rich primers which are applied at lower thicknesses (25 micrometers [one mil] or less). Further information regarding these and other zinc-rich primers can be found in SSPC-PS Guide 12.00, "Guide to Zinc-Rich Coating Systems."

### 2. Description

**2.1** This painting system consists of blast cleaning and one coat of zinc-rich paint. This class of coatings is uniquely defined by its capability of galvanically protecting steel exposed in discontinuities such as narrow scratches and holidays. This protective mechanism minimizes undercutting and pining attack.

**2.2** This specification defines the application and field performance requirements for a one-coat zinc-rich system, and should be used in conjunction with SSPC-Paint 20, "Zinc-Rich Primers (Type I - Inorganic and Type II - Organic)," which defines the minimum compositional and laboratory requirements for identifying zinc-rich coatings; and other SSPC specifications covering surface preparation, application, thickness, inspection and safety (Note 10.2). If topcoating will be required, refer to Section 10.6 of this specification.

### 3. Reference Standard

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **Paint 20** | Zinc-Rich Primers (Type I - Inorganic and Type II - Organic) |
| **Paint 29** | Zinc Dust Sacrificial Primer, Performance-Based |
| **PS Guide 12.00** | Guide to Zinc-Rich Coating Systems |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1** SSPC-SP 6, "Commercial Blast Cleaning," for new steel; SSPC-SP 10, "Near-White Blast Cleaning," for previously painted or pitted steel. If specified in the procurement documents, better degrees of blast cleaning shall be substituted (SSPC-SP 5, "White Metal Blast Cleaning," or SSPC-SP 10, "Near-White Blast Cleaning").

COMMENT: While blast cleaning to a white metal is always preferred, this surface preparation is often difficult and expensive to achieve. A near-white metal blast cleaning or in some cases a commercial blast cleaning will often provide a satisfactory surface for these coatings. Although this specification is written for blast cleaned surfaces, under certain conditions pickling can be used for Type IC (solvent base inorganic) and Type II (organic) zinc-rich primers if agreed upon by the contracting parties. The pickling procedures shall be in accordance with SSPC-SP 8, "Pickling," paragraph 5.2.1. Specifically, this requires

Provided by : www.spic.ir Licensee: NISOC Library

adequate rinsing of all pickling residues with 60°C (140°F) hot water, and prohibits subsequent phosphoric acid or dichromate immersion.

The degree of deviation from the ideal which zinc-rich coatings will tolerate without serious loss of their properties varies considerably from coating to coating. Therefore, adequate instructions from the manufacturer are essential and must be closely followed to insure maximum performance.

A general guideline for surface preparation under various exposures is as follows:

| Exposure | Recommended Minimum Surface Preparation |
|---|---|
| **Immersion** — Continuous immersion or condensation | SSPC-SP 5 |
| **Splash/Spillage** — Frequent condensation, splash, spray, spillage, and high fume concentrations | SSPC-SP 5 |
| **Chemical Fume** — Relatively high fume concentrations, no no splash | SSPC-SP 10 |
| **Atmospheric** — Non-corrosive fume concentration and outside weathering | SSPC-SP 6 |

The nominal blast profile should be within the range of 40 to 90 micrometers (1.5-3.5 mils). A Surface Profile Comparator is available from SSPC for sand, grit, or shot blast cleaned surfaces. Alternatively, replica tape, depth micrometer, stylus, microscopic measurement methods, or other suitable techniques may be used.

## 5. Paints

**5.1 PRIMER:** SSPC-Paint 20, "Zinc-Rich Primers (Type I - Inorganic and Type II - Organic)". (See Note 10.2.)

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow the requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

COMMENT: Zinc-rich coatings are preferably applied by spray due to advantages of this method, but some may be roller coated or brushed to force paint into surface irregularities. Normally, inorganic zinc-rich primers should not be applied by brush. During application, frequent mixing of the paint is essential to ensure uniform pigment suspension, and when applying by spray method, use of a continuously agitated pot is recommended. Paint supplier's recommendations should be followed.

The mixing of a multi-package zinc-rich coating should be as follows: stir the fluid vehicle until homogeneous, and pour it into the mixing container. Sift in the zinc powder in small quantities, mixing it in thoroughly. Mix until the powder is well dispersed. Pass the mixture through a 30-mesh screen to remove any lumps. When spraying, it is also good practice to use a 30-mesh in-line at the paint intake.

**6.2 TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and in particular with section thereof entitled "Field Painting." Unless otherwise specified, touch-up painting shall be done in the field with a compatible organic zinc-rich primer.

**6.3 NUMBER OF COATS:** One.

**6.4 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than 64 micrometers (2.5 mils) as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages."

COMMENT: Because of the high pigment content of zinc-rich primers, and their tendency to mudcrack at excessive thicknesses, it is recommended that zinc-rich coatings not be applied to dry film thicknesses greater than 125 micrometers (5 mils) per coat.

**6.5** In the event of mudcracking or loss of adhesion, the non-adherent zinc-rich coating shall be suitably removed and reapplied.

## 7. Field Performance

The following in-service field exposure or application histories shall be required:

**7.1 FROM THE COATING SUPPLIER:** A three-year minimum case history of satisfactory service in an environment similar to that intended. The names and addresses of previous users who can give information regarding coating service performance must be included. The specifier shall determine the applicability of this data for his specific use.

**7.2 FROM THE COATING APPLICATOR:** The names and addresses of responsible company officials for whom the applicator has done coating work. References should include a recent job, and a job where a zinc-rich primer had been applied. The user shall determine the applicability of this data for his specific use.

**7.3** Additionally, or in lieu of suitable in-service field exposure or application histories as described above, the coating supplier, coating applicator, and user shall establish a criterion of performance agreeable to all parties.

## 8. Inspection

**8.1** All work and materials supplied under this specifi-

Provided by : www.spic.ir Licensee: NISOC Library

cation are 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. (See Note 10.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**8.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**8.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 9. Disclaimer

**9.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**9.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 10. Notes

Notes are not a requirement of this specification.

**10.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**10.2 ALTERNATIVE SPECIFICATION:** Coatings conforming to SSPC-Paint 29, "Zinc Dust Sacrificial Primer, Performance-Based" may also satisfy the requirements of this specification.

**10.3 MANUFACTURER'S LITERATURE:** This specification is intended to be supplemented by the coating manufacturer's instructions and literature. If the manufacturer's literature or recommendations are to become part of the requirements of a procurement document, they must be submitted as part of the design, or bidding document. The date of the manufacturer's literature and the number of sheets should be listed. In the event of a conflict between the manufacturer's written instructions and this specification, the specifier, or other appropriate authorities, shall be notified to provide clarification.

**10.4 FAYING SURFACES:** Certain zinc-rich primers, when untopcoated, provide sufficient friction to allow their use on faying surfaces of high tensile bolt connections. The coating manufacturer should be consulted regarding the suitability of the zinc-rich primer for this purpose.

**10.5 QUALITY ASSURANCE:** The user should insure that coatings tested according to SSPC Paint 20, "Zinc-Rich Primers (Type I - Inorganic and Type II - Organic)" will not be different than those actually applied at the job site. This assurance can be obtained for vehicle components by obtaining infrared spectrographic curves from the laboratory test sample and comparing them with curves obtained from IR tracings of selected field samples. Pigment components may be similarly compared using atomic absorption or other spectrographic analyses. If there are any significant differences between the tracings obtained from the laboratory and field coating samples, the coating manufacturer should be consulted.

**10.6 TOPCOATING:** Although not required by this specification, suitable topcoating will provide additional service life. Topcoats must be formulated not only for environmental resistance, but also for suitable application (to minimize pinholing, bubbling, etc.) over a zinc-rich primer. In general, topcoating will be required in the more severe service environments. The following is a guide.

**10.6.1 Immersion:** Extreme caution should be exercised when using zinc-rich coatings in conjunction with cathodic protection to protect steel in immersion. For aqueous immersion service without cathodic protection they may be topcoated with a suitable topcoat. Zinc-rich coatings are satisfactory for many non-aqueous immersion services provided trace zinc contamination is not important. If contamination can occur, a suitable resistant topcoat may be employed.

**10.6.2 Splash/Spillage:** When coatings for appearance and protection of process equipment and structural materials are within a process area and exposed to process fumes and frequent splash and spillage of process chemicals, resistant topcoats may provide additional service life.

**10.6.3 Chemical Fume:** Coatings that are exposed to moderate and high concentrations of corrosive fumes and weather, but no splash or spillage, may be topcoated to provide additional service life.

Provided by : www.spic.ir Licensee: NISOC Library

**10.6.4 Atmospheric:** Coatings primarily for appearance in yard areas and service buildings—exposure to noncorrosive fumes and weathering only. Topcoating may provide additional service life, but zinc-rich primer alone is sufficient to provide long-term protection.

**10.7 WET ABRASIVE BLAST CLEANING:** Dry abrasive blast cleaning may not be permitted in certain areas, and wet abrasive blast cleaning may be an alternative.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 13.01
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 13.01

## Epoxy Polyamide Painting System

### 1. Scope

**1.1** This specification outlines a three-coat epoxy polyamide painting system for the protection of steel surfaces subject to industrial exposure, marine environments, and areas subject to chemical exposure such as acid and alkali.

**1.2** This system, when properly applied and cured, is capable of giving excellent protection to steel surfaces in Environmental Zones 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 3A (chemical, acidic), 3B (chemical, neutral), and 3C (chemical, alkaline), but not in potable water tanks. Although the coating herein specified has exhibited good chemical protection, its resistance against specific chemicals should, in the absence of applicable case histories, be appropriately tested.

### 2. Description

**2.1** This painting system consists of surface preparation by SSPC-SP 6, "Commercial Blast Cleaning, and application of an epoxy polyamide primer, intermediate, and topcoat specified in SSPC-Paint 22, "Epoxy Polyamide Paints (Primer, Intermediate, and Topcoat)."

**2.2** Each coating of this system (primer, intermediate, and topcoat) is a two-part product consisting of a base component and a curing agent component. The base component contains an epoxy resin together with corrosion-resistant pigments, prime color pigments, mineral fillers, gellant, leveling agent, and volatile solvents as appropriate to meet the performance requirements. The curing agent component contains a liquid type polyamide resin and volatile solvents.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 through 3.7 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 22** | Epoxy Polyamide Paints (Primer, Intermediate, and Topcoat) |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **B 117** | Practice for Operating Salt Spray (Fog) Apparatus |
| **D 714** | Test Method for Evaluating Degree of Blistering of Paints |
| **D 1654** | Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |
| **G 23** | (canceled) Practice for Operating Light-Exposure Apparatus (Carbon Arc Type) With and Without Water for Exposure of Non-Metallic Materials [Replaced with appropriate cycle of G 151 – G 155.] |

**3.7 FEDERAL STANDARDS AND SPECIFICATIONS:**

| | |
|---|---|
| **MIL-DTL-24441** | Paint, Epoxy Polyamide, General Specification for (Formerly MIL-P-24441) |

### 4. Surface Preparation

**4.1** SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents,

Provided by : www.spic.ir Licensee: NISOC Library

better degrees of blast cleaning shall be substituted (SSPC-SP 5, "White Metal Blast Cleaning," or SSPC-SP 10, "Near-White Blast Cleaning").

## 5. Paints

**5.1 PRIMER:** SSPC-Paint 22, "Epoxy Polyamide Paints," primer.

**5.2 INTERMEDIATE (SECOND COAT):** SSPC-Paint 22, "Epoxy Polyamide Paints," intermediate.

**5.3 FINISH COAT:** SSPC-Paint 22, "Epoxy Polyamide Paints," topcoat.

## 6. System Requirements

**6.1 TEST PANELS:** Test panels shall be carbon steel, minimum size of 10 x 20 x 0.3 cm (4 x 8 x 1/8 inch) unless otherwise specified. They shall be blast cleaned in accordance with SSPC-SP 10, "Near-White Blast Cleaning." The coating system shall be spray applied and air dried. Air drying and test conditions shall be 23 to 27°C (74 to 80°F) and 40 to 50 percent relative humidity. Final dry film thickness shall be between 175 and 225 micrometers (7 and 9 mils).

**6.2 ADHESION:** Prepare four panels as in Section 6.1. Scribe an "X" as per ASTM D 1654, in the lower half of each panel down to the bare metal, and coat the back and edges of the panels with a fast-dry paint. Then place the panels in a distilled water bath at 23 to 27°C (74 to 80°F) so that the "X" scribe is completely submerged. After five days in immersion, remove the panel, allow four hours recovery time, and test the adhesion by attempting to separate the coats with the knife. Any delamination shall constitute failure.

**6.3 SALT SPRAY RESISTANCE:** Prepare at least two test panels as in Section 6.1. Protect the backs and edges. Expose for 1000 hours to five percent salt spray in accordance with ASTM B 117. During the test, the panels shall be inclined at an angle of 15 degrees off the vertical. At the end of the test period there shall be no blistering or underfilm corrosion.

**6.4 ACCELERATED WEATHERING:** Prepare two 7.6 x 15 cm (3 x 6 inch) steel panels as in Section 6.1. Expose to accelerated weathering for 500 hours in accordance with ASTM G 23. At the end of the test period the coating system shall show no cracking, checking, or film failure other than chalking or loss of gloss.

**6.5 CHEMICAL RESISTANCE:** Prepare a test panel as in Section 6.1 except allow to cure for 14 days at room temperature prior to conducting spot test. Place a small piece of absorbent cotton or filter paper on the test panel. Apply two to six drops of test solution and cover with a 2.5 cm (1 inch) watch glass. Allow to stand 24 hours. Wash panel with water and examine immediately, and after an eight-hour recovery. Staining may occur with certain colored topcoats. Typical performance is as follows:

5% by weight, sodium hydroxide—no effect
5% by weight, sulfuric acid—stain
5% by weight, phosphoric acid—no effect
5% by weight, ammonium hydroxide—no effect
5% by weight, acetic acid—slight blister (8F max, ASTM D 714)
5% by weight, hydrochloric acid—slight stain

## 7. Paint Application

**7.1 PAINT APPLICATION:** Follow the requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**7.2 RECOATING:** Each coat shall be air dried a minimum of four hours at 25°C (77°F) prior to recoating. Longer recoat times will be required at lower temperatures. Normal recoat time is within 72 hours. Longer recoat times may require special surface preparation. These coatings shall not be applied at temperatures below 10°C (50°F).

**7.3 MAINTENANCE PAINTING:** The provisions of SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base and Alkyd Painting Systems" should be followed.

**7.4 NUMBER OF COATS:** Minimum of three.

**7.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurements of Dry Coating Thickness with Magnetic Gages"—primer 64 micrometers (2.5 mils); intermediate coat 64 micrometers (2.5 mils); finish coat 50 micrometers (2.0 mils); for the three-coat paint system 175 micrometers (7.0 mils). The dry film thickness of the three-coat system shall not exceed 380 micrometers (15 mils).

## 8. Inspection

**8.1** All work and materials supplied under this specification are 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. (See Note 10.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

Provided by : www.spic.ir Licensee: NISOC Library

**8.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**8.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 9. Disclaimer

**9.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**9.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 10. Notes

Notes are not a requirement of this specification.

**10.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**10.2** The coatings listed in this specification are compatible with one another.

**10.3** This specification applies to both new construction and maintenance painting.

**10.4** Reference is made to MIL-P-24441, "Paint, Epoxy Polyamide, General Specification for,'' designed for both fresh and salt water immersion service, where lead-free or higher flash point epoxy paints are required. MIL-P-24441 has been superseded by MIL-DTL-24441.

**10.5** Alternate formulations to meet air pollution requirements and regulations shall pass the performance criteria of this specification.

**10.6** Other generic topcoats may be used for improved color and gloss retention.

**10.7** Alternative two-coat system high-build can be used provided it meets the performance criteria in this specification.

**10.8** It is well recognized that epoxy polyamide systems are often applied over zinc-rich primers. This will result in superior long-term protection. However, the manufacturer's instructions need to be followed for the proper application technique. Such coating systems may also include an aliphatic urethane topcoat.

**10.9 ALTERNATIVE FORMULATIONS:** Salt fog exposure and other test requirements may be added as agreed upon in the contract.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 14.01

## Steel Joist Shop Painting System

### 1. Scope

**1.1** This specification covers a one-coat shop joist primer that will provide temporary protection to the steel joists during delivery and erection.

**1.2** This system is intended as a one-coat shop paint for open web and long span steel joists that may be either enclosed or exposed in the interiors of buildings (Environmental Zone 1A, interior, normally dry) where the temperature rarely falls below the dew point, where the humidity rarely exceeds 85 percent, and where corrosion protection is not necessary.

### 2. Description

**2.1** This painting system consists of surface preparation by solvent cleaning and one coat of primer.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **Paint 15** | Steel Joist Shop Paint |
| **PS Guide 1.00** | Guide to Selecting Oil Base Painting Systems |
| **SP 1** | Solvent Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1** Use SSPC-SP 1, "Solvent Cleaning," to remove heavy deposits of oil and grease. Other cleaning shall be done by the method elected by the fabricator.

### 5. Paints

**5.1 PRIMER:** SSPC-Paint 15, "Steel Joist Shop Paint."

### 6. Paint Application

**6.1 PAINT APPLICATION:** Paint shall be applied in a professional manner by the method used in the fabricator's shop. Paint shall not be applied to wet, frosted, or hot surfaces.

**6.1.1** Joists fabricated in the shop shall be primed in the shop unless otherwise specified.

**6.1.2** Painted joists shall be allowed to dry before shipment.

**6.2 TOUCH-UP PAINTING:** Touch-up painting shall be done in the field with either the same paint as the shop coat or any other compatible primer.

**6.3 NUMBER OF COATS:** One coat shall be required.

**6.4 DRY FILM THICKNESS:** Not less than 25 micrometers (one mil).

### 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

Provided by : www.spic.ir Licensee: NISOC Library

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**9.2 TOPCOATING:** Oil/alkyd type coatings of this system can usually be topcoated without difficulty and are compatible with the finish paints listed in SSPC-PS Guide 1.00, “Guide for Selecting Oil Base Painting Systems.” Asphalt coatings will bleed through most paints. If topcoating is anticipated for aesthetic purposes, it is recommended that the appropriate generic type of shop paint be specified.

**9.3** This specification was jointly developed by the Steel Joist Institute and SSPC in cooperation with the American Institute of Steel Construction.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM GUIDE NO. 15.00

## Guide for Selecting Chlorinated Rubber Painting Systems

This Guide offers to the specifier a selection of chlorinated rubber painting systems that will provide good protection for steel structures exposed in a variety of environments. Select the desired surface preparation, primer, intermediate(s), and topcoat from those listed herein and insert them into the standard SSPC Painting System format. In order to aid in the selection, short comments are given. For additional information consult the "Commentary on Painting Systems" and the referenced standards.

## 1. Scope

**1.1** These specifications cover chlorinated rubber painting systems for blast cleaned or pickled steel. These coatings are not recommended for areas exposed to strong organic solvents, oxidizing acids, or the areas where the surface temperature exceeds 74°C (165°F). Straight chain unsaturated acids, and fats and oils of animal or vegetable origin will cause softening and swelling of these coatings.

**1.2** These systems are suitable for use on parts or structures exposed in Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 2C (fresh water immersion), 2D (salt water immersion), 3A (chemical, acid), 3B (chemical, neutral), and 3C (chemical, alkaline).

**1.3** Chlorinated rubber paints are single-package systems that dry by solvent evaporation and have low permeability to water vapor and oxygen. After drying, they are nonflammable and resistant to mildew growth.

**1.4** The color of the finish must be specified.

## 2. Description

**2.1** This guide outlines the components of a complete chlorinated rubber painting system. A standard system consists of surface preparation by commercial blast cleaning or pickling, one coat of chlorinated rubber primer, one intermediate coat, and one finish coat.

## 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 through 3.7 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 17** | Chlorinated Rubber Inhibitive Primer |
| **Paint 18** | Chlorinated Rubber Intermediate Coat Paint |
| **Paint 19** | Chlorinated Rubber Topcoat Paint |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL STANDARD:**

| | |
|---|---|
| **TT-P-1046** | (canceled) Primer Coating: Zinc Dust, Chlorinated Rubber, (for Steel and Galvanized Surfaces) |

## 4. Surface Preparation

**4.1** SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents, better degrees of blast cleaning shall be substituted (SSPC-

Provided by : www.spic.ir Licensee: NISOC Library

SP 5 or 10).

COMMENT: Overall coating system performance is a function of surface preparation. Blast cleaning or pickling of the steel is the minimum recommended surface preparation for new work.

For highly corrosive conditions and immersion service, a minimum of SSPC-SP 10, "Near-White Blast Cleaning" or SSPC-SP 8, "Pickling" is recommended. Mill scale is particularly detrimental on immersed or wet steel.

For less severe environments, SSPC-SP 6, "Commercial Blast Cleaning," may be used. SSPCSP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning," may be substituted only where blast cleaning is impossible, i.e., area access is limited, or environmental requirements are involved.

## 5. Paints

**5.1 CHLORINATED RUBBER PRIMERS:** After cleaning, the steel shall be primed with one coat of paint conforming with the following specification.

COMMENT: Due to the limited protection afforded by shop primers, prolonged field exposure before fabrication should be avoided. Where prolonged exposure is anticipated, consideration should be given to two coats, each 38 micrometers (1.5 mils) dry film thickness, of shop primer. One coat may not provide adequate protection for more than 90 days.

Whenever chlorinated rubber paint systems are to be used over galvanized steel or nonferrous metals, a wash primer is recommended to insure good adhesion.

**5.1.1 SSPC-Paint 17, "Chlorinated Rubber Inhibitive Primer":**

COMMENT: When this preferred primer is used, excellent total system performance results. The primer affords ease of application, subsequent coat adhesion (whether shop or field applied), flexibility and durability of the total paint system; it also affords a high degree of impermeability, resistance to abrasion, and protection against corrosive environments.

**5.1.2 Proprietary Primer:**

COMMENT: A proprietary primer of proved performance capability may be substituted for the above if desired by the specifier. Specify the manufacturer, trade name, and product number of the desired proprietary paint.

Several generic types of proprietary primers may be used. They include modified chlorinated rubber, chemically- cured epoxy, zinc-rich paints, or those coatings specifically recommended by the manufacturer. Where subsequent coats from different manufacturers are involved, compatibility tests must be made.

**5.2 INTERMEDIATE COAT(S) FOR CHLORINATED RUBBER PAINTING SYSTEMS:**

**5.2.1 SSPC-Paint 18, "Chlorinated Rubber Intermediate Coat Paint":**

COMMENT: When this preferred intermediate coat is used, minimum film thickness coating system requirements are readily obtained.

**5.3 CHLORINATED RUBBER FINISH COATS:**

**5.3.1 SSPC-Paint 19, "Chlorinated Rubber Topcoat Paint":**

COMMENT: When this preferred topcoat is used, maximum resistance is obtained in most chemical and corrosive environments.

**5.3.2 Proprietary Finish Paint:**

COMMENT: A proprietary finish paint of proved performance capability may be substituted for any of the above if desired by the specifier. Specify the manufacturer, trade name, product number, and color of the desired proprietary paint.

Several types of proprietary topcoats may be used. They include alkyd, acrylic, or hydrocarbon modifications to improve gloss and color retention. However, overall chemical corrosion resistance may be impaired.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

COMMENT: Chlorinated rubber paints can be applied over a surface temperature range of 2 to 49°C (35 to 120°F), where the surface temperature is at least 3°C (5°F) above the dew point at the time of application. Under special conditions and when no ice is present on the surface, these coatings can be applied at temperatures as low as -15°C (5°F).

Sufficient time should be allowed for air drying between coats to insure solvent removal. Solvent entrapment can occur with single-coat applications if the dry film thickness is more than 125 micrometers (5 mils).

**6.2 FIELD TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and in particular with the section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** For maintenance painting procedures, see SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems."

COMMENT: This guide covers the steps necessary for repainting previously painted steel surfaces.

**6.4 NUMBER OF COATS:** Two or three.

COMMENT: A primer coat followed by both an interme-

Provided by : www.spic.ir Licensee: NISOC Library

diate coat and a topcoat is ordinarily required. For less severe environments, a primer coat meeting SSPC-Paint 17, "Chlorinated Rubber Inhibitive Primer," followed by a coat meeting SSPC-Paint 18, "Chlorinated Rubber Intermediate Coat Paint," or SSPC-Paint 19, "Chlorinated Rubber Topcoat Paint," may be used, provided that the total dry film thickness applied is at least 100 micrometers (4.0 mils).

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC- PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 38 micrometers (1.5 mils); intermediate, if specified, 75 micrometers (3.0 mils); topcoat 38 micrometers (1.5 mils); for a three-coat system 150 micrometers (6.0 mils); for a two-coat, if specified, system 100 micrometers (4.0 mils).

## 7. Inspection

**7.1** All work and materials supplied under this specification is 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 15.01
March 1, 1985
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 15.01

## Chlorinated Rubber Painting System for Salt Water Immersion

### 1. Scope

**1.1** This specification covers a complete chlorinated rubber painting system for structural steel.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zones 2B (frequently wet by salt water), and 2D (salt water immersion).

**1.3** The finish paint allows for a choice of colors.

### 2. Description

**2.1** This painting system consists of surface preparation by white metal blast cleaning, one coat of chlorinated rubber primer, one chlorinated rubber intermediate coat, one chlorinated rubber finish coat, and, when required, a finish coat of anti-fouling paint.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 17** | Chlorinated Rubber Inhibitive Primer |
| **Paint 18** | Chlorinated Rubber Intermediate Coat Paint |
| **Paint 19** | Chlorinated Rubber Topcoat Paint |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1** SSPC-SP 5, “White Metal Blast Cleaning.” If specified in the procurement documents, SSPC-SP 10, “Near-White Blast Cleaning,” or SSPC-SP 8, “Pickling,” shall be substituted.

### 5. Paints

**5.1 PRIMER:** SSPC-Paint 17, “Chlorinated Rubber Inhibitive Primer.”

**5.2 INTERMEDIATE COAT:** SSPC-Paint 18, “Chlorinated Rubber Intermediated Coat Paint.”

**5.3 FINISH COAT:** SSPC-Paint 19, “Chlorinated Rubber Topcoat Paint.

**5.4 ADDITIONAL FINISH COAT:** When specified in the procurement documents, an additional finish coat of an antifouling paint compatible with this chlorinated rubber painting system shall be applied.

### 6. Paint Application

**6.1 PAINT APPLICATION:** Follow the requirements of SSPC-PA 1, “Shop, Field, and Maintenance Painting of Steel.”

**6.2 FIELD TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, “Shop, Field, and Maintenance Painting of Steel,” and in particular with section thereof entitled “Field Painting.”

**6.3 MAINTENANCE PAINTING:** For maintenance painting procedures, see SSPC-PA Guide 4, “Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems.”

Provided by : www.spic.ir Licensee: NISOC Library

**6.4 NUMBER OF COATS:** Three. Four when an antifouling finish coat is specified.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 38 micrometers (1.5 mils); intermediate 75 micrometers (3.0 mils); finish coat 38 micrometers (1.5 mils); for a three-coat system 150 micrometers (6.0 mils); if specified, antifouling 100 micrometers (4.0 mils); for a four-coat system 250 micrometers (10.0 mils).

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 15.02
March 1, 1985
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 15.02

## Chlorinated Rubber Painting System for Fresh Water Immersion

### 1. Scope

**1.1** This specification covers a complete chlorinated rubber painting system for structural steel.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zones 2A (frequently wet by fresh water) and 2C (fresh water immersion). It may also be used in nonsolvent chemical atmospheres.

**1.3** The finish paint allows for a choice of colors.

### 2. Description

**2.1** This painting system consists of surface preparation by near-white blast cleaning or pickling, one coat of chlorinated rubber primer, one chlorinated rubber intermediate coat, and one chlorinated rubber finish coat.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 17** | Chlorinated Rubber Inhibitive Primer |
| **Paint 18** | Chlorinated Rubber Intermediate Coat Paint |
| **Paint 19** | Chlorinated Rubber Topcoat Paint |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1** SSPC SP 10, “Near-White Blast Cleaning,” or SSPC-SP 8, “Pickling.” If specified in the procurement documents, a better degree of blast cleaning shall be substituted (SSPC-SP 5).

### 5. Paints

**5.1 PRIMER:** SSPC-Paint 17, “Chlorinated Rubber Inhibitive Primer.”

**5.2 INTERMEDIATE COAT:** SSPC-Paint 18, “Chlorinated Rubber Intermediate Coat Paint.”

**5.3 FINISH COAT:** SSPC-Paint 19, “Chlorinated Rubber Topcoat Paint.”

**5.4 ADDITIONAL FINISH COAT:** When specified in the procurement documents an additional finish coat of SSPC-Paint 19, “Chlorinated Rubber Topcoat Paint,” shall be applied.

### 6. Paint Application

**6.1 PAINT APPLICATION:** Follow the requirements of SSPC-PA 1, “Shop, Field, and Maintenance Painting of Steel.”

**6.2 FIELD TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, “Shop, Field, and Maintenance Painting of Steel,” and in particular with section thereof entitled “Field Painting.”

**6.3 MAINTENANCE PAINTING:** For maintenance painting procedures, see SSPC-PA Guide 4, “Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems.”

Provided by : www.spic.ir Licensee: NISOC Library

**6.4 NUMBER OF COATS:** Three. Four when an additional finish coat is specified.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 38 micrometers (1.5 mils); intermediate 75 micrometers (3.0 mils); finish coat 38 micrometers (1.5 mils); for a three-coat system 150 micrometers (6.0 mils); if specified, additional finish coat 38 micrometers (1.5 mils); for a four-coat system 190 micrometers (7.5 mils).

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 15.03
March 1, 1985
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 15.03

## Chlorinated Rubber Painting System for Marine and Industrial Atmospheres

### 1. Scope

**1.1** This specification covers a complete chlorinated rubber painting system for structural steel.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 3A (chemical exposure, acidic), 3B (chemical exposure, neutral), and 3C (chemical exposure, alkaline).

**1.3** The finish paint allows for a choice of colors.

### 2. Description

**2.1** This painting system consists of surface preparation by commercial blast cleaning or pickling, one coat of chlorinated rubber primer, one chlorinated rubber intermediate coat, and one chlorinated rubber finish coat.

### 3. Reference Standards

**3.1** The standards referenced in this specification listed in Section 3.4 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Paint Thickness with Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 17** | Chlorinated Rubber Inhibitive Primer |
| **Paint 18** | Chlorinated Rubber Intermediate Coat Paint |
| **Paint 19** | Chlorinated Rubber Topcoat Paint |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

### 4. Surface Preparation

**4.1** SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents, better degrees of blast cleaning shall be substituted (SSPC-SP 10 or SSPC-SP 5).

### 5. Paints

**5.1 PRIMER:** SSPC-Paint 17, "Chlorinated Rubber Inhibitive Primer."

**5.2 INTERMEDIATE COAT:** SSPC-Paint 18, Chlorinated Rubber Intermediate Coat Paint."

**5.3 FINISH COAT:** SSPC-Paint 19, "Chlorinated Rubber, Topcoat Paint."

### 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 FIELD TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and in particular with Section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** For maintenance painting procedures, see SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base and Alkyd Painting Systems."

**6.4 NUMBER OF COATS:** Three.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Paint Thickness with Magnetic Gages": primer 1.5 mils (38 micrometers); intermediate 3.0 mils (76 micrometers); finish coat 1.5 mils (38

Provided by : www.spic.ir Licensee: NISOC Library

micrometers); for a three-coat system 6.0 mils (152 micrometers).

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 15.04
March 1, 1985
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 15.04

## Chlorinated Rubber Painting System for Field Application over a Shop-Applied Solvent Base Inorganic Zinc-Rich Primer

### 1. Scope

**1.1** This specification covers a field-applied chlorinated rubber painting system for structural steel shop-primed with a solvent base inorganic zinc-rich primer.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 3A (chemical exposure, acidic), 38 (chemical exposure, neutral), and 3C (chemical exposure, alkaline).

**1.3** The finish paint allows for a choice of colors.

### 2. Description

**2.1** This painting system consists of surface preparation by solvent cleaning, or brush-off blast cleaning, and two coats of a chlorinated rubber finish coat.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 18** | Chlorinated Rubber Intermediate Coat Paint |
| **Paint 19** | Chlorinated Rubber Topcoat Paint |
| **SP 1** | Solvent Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1** SSPC-SP 1, "Solvent Cleaning." If present, white rust and zinc oxidation products must be removed by SSPC-SP 7, "Brush-Off Blast Cleaning." If specified in the procurement documents, water blast cleaning with a minimum pressure of 1,000 psi may be used.

### 5. Paints

**5.1 INTERMEDIATE COAT:** SSPC-Paint 18, "Chlorinate Rubber Intermediate Coat Paint."

**5.2 FINISH COAT:** SSPC-Paint 19, "Chlorinated Rubber Topcoat Paint."

### 6. Paint Application

**6.1 PAINT APPLICATION:** Follow the requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel." Due to the porosity of the zinc primer, a wet mist coat or tack coat should be applied to reduce possible potential bubbling problems.

**6.2 FIELD TOUCH-UP PAINTING:** In accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and in particular with the section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** For maintenance painting procedures, see SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems."

Provided by : www.spic.ir Licensee: NISOC Library

**6.4 NUMBER OF COATS:** Two.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": intermediate 75 micrometers (3.0 mils); finish coat 38 micrometers (1.5 mils).

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 16.01
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 16.01

## Silicone Alkyd Painting System for New Steel*

### 1. Scope

**1.1** This specification covers a complete silicone alkyd painting system for structural steel.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zones 2A (frequently wet by fresh water) including high humidity, infrequent immersion, and mild chemical atmospheres.

**1.3** The primary virtue of this system is the exterior durability and minimum deterioration of the silicone alkyd finish as shown by chalk resistance, gloss retention, and color retention. In addition, the finish paint allows for a choice of colors.

### 2. Description

**2.1** This painting system consists of surface preparation by commercial blast cleaning or pickling, one coat of oil or alkyd primer, one intermediate coat of alkyd paint, and one finish coat of silicone alkyd paint.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 11*** | Red Iron, Zinc Chromate, Raw Linseed Oil and Alkyd Primer |
| **Paint 21** | White or Colored Silicone Alkyd Paint |
| **Paint 104** | White or Tinted Alkyd Paint |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1** SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents, a better degree of cleaning shall be substituted (SSPC-SP 5, "White Metal Blast Cleaning," or SSPC-SP 10, "Near-White Blast Cleaning").

### 5. Paints

**5.1 PRIMERS:** After cleaning, the steel shall be primed with one coat of paint conforming with one of the following specifications:

**5.1.1** SSPC-Paint 11*, "Red Iron Oxide, Zinc Chromate, Raw Linseed Oil and Alkyd Primer."

**5.1.2 Proprietary Primer:**
COMMENT: A proprietary primer of proven performance capability may be substituted for any of the above if desired by the specifier. Specify the manufacturer, trade name, and product number of the desired proprietary paint. The paint manufacturer should furnish a typical label analysis.

**5.2 INTERMEDIATE COAT:** SSPC-Paint 104, "White or Tinted Alkyd Paint," with a gloss no higher than 20 and tinted with carbon black or lampblack paste in oil to a shade contrasting with that of the finish coat.

**5.3 FINISH COAT:** SSPC-Paint 21, "White or Colored Silicone Alkyd Paint."

Provided by : www.spic.ir Licensee: NISOC Library

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow the requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," and in particular with the section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** The provisions of SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems," should be followed.

**6.4 NUMBER OF COATS:** Minimum of three.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 50 micrometers (2.0 mils); intermediate 38 micrometers (1.5 mils); finish coat 38 micrometers (1.5 mils); for a three-coat system 125 micrometers (5.0 mils).

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

* This paint contains chromate pigments. Users are urged to follow all health, safety, and environmental requirements in applying, handling or disposing of these materials.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS Guide 17.00
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM GUIDE NO. 17.00

## Guide for Selecting Urethane Painting Systems

### 1. Scope

**1.1** This guide outlines urethane painting systems for structural steel surfaces. There are three types of urethane coatings covered by the guide. They are Types II, IV, and V, as classified by ASTM Standard D 16.

COMMENT: One-Package Moisture-Cured Urethane Coating (Type II): This coating contains moisture curing isocyanate terminated prepolymers which cure by reaction with moisture from the atmosphere. Reduced cure rate will result from insufficient atmospheric moisture (low relative humidity).

Two-Package Catalyzed Urethane Coating (Type IV): This coating contains isocyanate terminated prepolymers which cure by reaction with a low molecular weight reactive catalyst. One package contains a prepolymer similar to Type II; the second package contains a relatively small quantity of catalyst to accelerate the room temperature cure. This coating has limited pot life after mixing.

Two-Package Polyisocyanate Polyol-Cured Urethane Coating (Type V): This coating contains isocyanate terminated prepolymers which cure by reaction with hydroxylbearing polyols. One package contains the isocyanate terminated prepolymers and the second package contains a large quantity of resinous material containing active hydrogen groups. This coating also has limited pot life after mixing.

**1.2** These painting systems are suitable for use on parts or structures exposed in varied types of environments ranging from severely corrosive environments to mild atmospheric conditions.

**1.3** These painting systems are intended principally for structural steel where excellent weathering, color retention, and chemical resistance is desired. The color of the finish must be specified.

### 2. Description

**2.1** This guide outlines the components of a complete urethane painting system. A painting system shall consist of surface preparation by commercial blast cleaning or pickling, one coat of a compatible primer, and one or more urethane topcoats.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 through 3.7 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 16** | Terminology Relating to Paint, Varnish, Lacquer, and Related Products |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1 SSPC-SP 6**, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents, better degrees of blast cleaning shall be substituted (SSPC-SP 5, "White Metal Blast Cleaning," or SSPC-SP 10, "Near-White Blast Cleaning").

COMMENT: For new steel, blast cleaning or pickling of the steel is the minimum recommended surface preparation. Better degrees of blast cleaning (SSPC-SP 5 or 10) may be substituted. These methods are more thorough,

Provided by : www.spic.ir Licensee: NISOC Library

and the better cleaning they provide may be more economical or may be required in corrosive conditions. Millscale is particularly detrimental to the life expectancy of coatings in immersion or wet service.

In maintenance repainting, if blast cleaning is not feasible, hand or power tool cleaning (SSPCSP 2 or 3) may suffice. These lesser degrees of surface preparation will reduce the service life of the coating system.

## 5. Paints

**5.1 PRIMERS:** After cleaning, the steel shall be primed with one coat of compatible primer.

COMMENT: Typical types of compatible primers include organic and inorganic zinc rich, epoxy, universal type copolymer primers, urethane, and wash primers.

Primers which can be topcoated with urethane coatings are available for use over lesser degrees of surface preparation (SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning"). Over such cleaned surfaces these primers will perform less effectively.

**5.2 INTERMEDIATE COAT:** Where an intermediate coat is required, it must be compatible with both the prime coat and the finish coat, but preferably in a contrasting color. Other generic intermediate coats as recommended by the coating supplier can also be used.

**5.3 URETHANE TOPCOATS:** Aliphatic and aromatic urethane topcoats can be used.

COMMENT: Aliphatic urethane topcoats are recommended where the highest degree of gloss and color retention, along with chemical resistance and recoatability, are desired.

Aromatic urethane topcoats are recommended where gloss and color retention are not required, but where chemical and abrasion resistance are desired. Aromatic urethanes require mechanical abrasion prior to recoating.

Typical properties of these urethane topcoat types are shown in Table 1.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

COMMENT: The primer and all subsequent coats must be compatible. Therefore, before using urethane coatings on previously coated surfaces other than those recommended, compatibility tests should be made for possible lifting or intercoat adhesion problems. Aliphatic urethanes normally have good recoatability while aromatic urethanes require mechanical abrasion prior to recoating.

Application may be by brush, roller, air spray, airless spray, electrostatic spray, or a combination of these methods. Dipping, flow coating, or hot spray is permitted only when specifically authorized by the coating supplier.

Some urethane coatings cure at temperatures as low as -7°C (20°F) and some can be applied as thick as 150 to 200 micrometers (6 to 8 mils) dry film thickness in one application. Drying times and minimum elapsed time permissible between coats of urethane coatings may vary with type and coating supplier. Particular attention should be paid to these points. Usually, it is good practice to obtain the complete coating system from one supplier.

Consult the coating supplier for special handling, industrial hygiene, and storage instructions.

**6.2 FIELD TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel" and in particular with the Section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** For maintenance painting procedures, see SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems."

COMMENT: This guide covers the steps necessary for repainting previously painted steel surfaces.

**6.4 NUMBER OF COATS:** A minimum of two.

COMMENT: The number of coats will depend upon the service environment, and the recommendations of the coating supplier should be followed.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Film thickness shall be measured in accordance with SSPC- PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages."

COMMENT: The recommended dry film thickness of each coat of the complete paint system may vary with the end use and metal surface preparation. Prior to application, the desired thickness of each coat should be agreed upon. The recommendations of the supplier should be followed.

## 7. Inspection

**7.1** All work and materials supplied under this specification is 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. (See Note 10.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**RECOMMENDATIONS FOR PHYSICAL AND CHEMICAL PROPERTIES OF URETHANE COATINGS**

| | TYPE II | | TYPE IV | | TYPE V | |
|---|---|---|---|---|---|---|
| | Aliphatic | Aromatic | Aliphatic | Aromatic | Aliphatic | Aromatic |
| | (One Package Moisture Cure) | | (Catalyzed Moisture Cure) | | (Two Package) | |
| Weatherability | R | LR | R | LR | R | LR |
| Gloss Retention* | R | LR | R | LR | R | LR |
| Color Retention | R | LR | R | LR | R | LR |
| Flexibility | R | R | R | R | R | R |
| Abrasion Resistance | R | R | R | R | R | R |
| Chemical Resistance, (Splash, Spill, Fumes)** | | | | | | |
| Acids (Mineral) | LR*** | LR*** | LR*** | LR*** | LR*** | LR*** |
| Acids (Organic) | LR | LR | LR | LR | LR | LR |
| Alkaline | R | LR | NR | NR | R | LR |
| Gases (Atmospheric) | R | R | R | R | R | R |
| Oxidizing Agents | LR | LR | NR | NR | LR | LR |
| Solvents | R | R | R | R | R | R |
| Salt Spray | R | R | LR | LR | R | R |
| Weather Resistance | R | R | LR | LR | R | R |
| Performance Range (Dry) -40° to 120˚C (-40˚ to 250˚ F) | R | R | R | R | R | R |

LEGEND:
R = Recommended
LR - Limited Recommendation
NR = Not Recommended

*Depends on pigmentation.
**For immersion, see supplier.
***See supplier for specific end-uses.

NOTE: Aromatic urethanes are not recommended for outdoor exposure where color and gloss retention are of prime importance.

time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Safety

**8.1** All safety requirements stated in this specification and its component parts apply in addition to any applicable federal, state, and local rules and requirements. Instructions of the paint manufacturer and requirements of insurance underwriters must be considered.

**8.2** Paints are hazardous because of their flammability and potential toxicity. Proper safety precautions shall be observed to protect against these recognized hazards. Safe handling practices are required and should include, but not be limited to, the provisions of SSPC-PA Guide 3, "A Guide to Safety in Paint Application."

**8.3** The paints specified herein may not comply with some air pollution regulations because of their hydrocarbon solvent content.

**8.4** Ingredients in urethane coatings which may pose a hazard include isocyanates and solvents. Applicable regulations governing safe handling practices shall apply to the use of urethane coatings.

**8.5** The main items to consider and keep in mind when working with urethane paint systems are as follows:

- Become informed and aware of the hazards and appropriate control procedures. This can be done by reading the label, the material safety data

Provided by : www.spic.ir Licensee: NISOC Library

sheet, if available, or by contacting the supplier of the paint system for other literature and information.

- Follow the recommendations prescribed for use during handling and application as set forth by the supplier.
- Follow all applicable local, state, and federal regulations.

**8.6** Label information should be available if medical attention is required.

COMMENT: Toxicological research as well as practical experience has shown that diisocyanates can cause irritation of the skin, respiratory tract, eyes, nose and throat. In addition, sensitization resulting in allergic dermatitis or asthmatic symptoms can occur following overexposure to diisocyanates. Toxicological research has shown that polyisocyanates have a reduced potential to cause irritation and sensitization relative to their monomeric precursors.

Irritation is an acute response which results from the direct contact of isocyanates on the body surface, i.e., skin, mucous membranes of the nasal passages, throat and respiratory tract, eyes, etc. Symptoms usually include watering of the eyes, and a burning sensation in the nose and throat. The amount of irritation is dependent upon the dose, tissue exposed and individual susceptibility, but it is generally independent of the individual's exposure history. These acute symptoms are generally reversible soon after the individual is removed from the contaminated area or removal of the material from the skin in cases of skin contact.

Sensitization is a systemic response and is not limited to the area of contact. Sensitization usually occurs as a result of numerous overexposures or one exposure to very high concentrations. Both respiratory and dermal sensitization can occur depending upon the toxicologic properties of the diisocyanate, route of exposure and individual susceptibilities. Exposures subsequent to the exposure(s)) which actually resulted in sensitization may cause a very strong allergic type of reaction. In the case of respiratory sensitization the reaction is similar to asthma, i.e., coughing, wheezing, tightness in the chest, and shortness of breath. The skin sensitization reaction is allergic dermatitis which may include symptoms such as rash, itching, hives, and swelling of the arms and legs. A sensitized individual may react to extremely low airborne levels even well below the threshold limit value (TLV).

If an individual experiences an irritation response while handling an isocyanate it should be determined whether or not the isocyanate was the cause of the irritation. If the isocyanate is the cause, it is an indication that the operation, as performed, allows an overexposure to isocyanates which can result in later sensitization of that worker or others. A careful evaluation of the controls, protective equipment, and work practices, should be made to reduce the exposure. If irritation persists in spite of proper ventilation and protective measures, the individual must be removed from areas where isocyanates are being processed or used.

If an individual is sensitized to isocyanates, complete removal from areas of potential exposure is mandated. This is true regardless of whether the isocyanate is present in vapor or mist form. Also, exposure to an isocyanate, other than the one suspected of causing the sensitization, must be avoided.

Solvents are also present in paints. Prolonged or repeated exposure or overexposure to these solvents by either inhalation or direct skin contact may also cause injurious health effects. The effects are dependent upon the solvent, the extent of exposure, and the route of exposure.

Protective Measures: Since isocyanates have the potential to irritate and sensitize those working with or around them, it is important that proper steps be taken to protect those potentially exposed from excessive contact with vapor, mist, or overspray. This includes those actually handling the isocyanate as well as those in the immediate vicinity. Even during brush, roller, and curtain coating applications, it is possible to be exposed to airborne concentrations of solvents and isocyanate vapors. During spray application, not only will vapors be present, but also spray mists or aerosolized droplets. These droplets contain pigments, solvents, resins, additives, and polymeric materials, as well as isocyanate and unreacted polyisocyanate. Each of these will have their own physiological effect on the organism.

Ideally, control of health hazards posed by vapors and spray mist is performed by engineering controls. Effective engineering controls should be used whenever possible to eliminate or reduce workers' exposure. There are several engineering controls available to reduce exposure to isocyanate vapors and mists. The most common is a properly designed and ventilated enclosure. General ventilation, local ventilation, or isolation may prove adequate under certain conditions. Use of alternative application equipment, e.g., airless or electrostatic spray equipment, may help reduce spray mist generation during spray painting. Brush and roller application of the coating may be feasible in some cases. To reduce environmental contamination, exhausted air may need to be cleaned by means of filters or scrubbers. The final design and combination of these control measures is dependent upon the specific application.

Whenever a paint system is spray-applied it is essential that the applicator be protected from inhalation of both vapors and spray mists by the best possible respiratory protection. Under certain conditions, a fresh air supplied respirator will be required. In other cases, an air purifying type with a particulate filter may be employed. Applicators are urged to consult with their suppliers concerning the type of respiratory protection appropriate in a given application.

The appropriate selection and use of a respirator is an important part of protection from work related chemical hazards. Other things also must be remembered and followed:

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**LISTING OF TYPICAL URETHANE SPECIFICATIONS AND END-USE APPLICATIONS**

| SPECIFICATION | END-USE APPLICATIONS |
|---|---|
| Canadian Government Specifications Board 1-GP-177 (November 1977), "Coating, Polyurethane Two-Package, Interior and Exterior, Non-Yellowing, Non-Chalking." | Interior and exterior use on metal, wood, glass fiber reinforced plastic, and concrete where excellent resistance to chemicals, abrasion, impact, water, corrosion, and superior exterior durability, non-yellowing, and non-chalking properties are desired. |
| Canadian Government Specifications Board 1-GP-180 (November 1977), "Coating, Polyurethane Two-Package, Interior and Exterior, General Purpose." | This specification applies to a two-package polyurethane coating for interior and exterior use on metal, wood, glass fiber reinforced plastic, and concrete, where excellent resistance to abrasion, impact, water, and corrosion are desired, and where some yellowing and chalking are not objectionable. |
| MIL-PRF-85285*, Coating: Polyurethane, High-Solids | For use on aircraft as a topcoat, steel storage tanks and ground equipment where gloss, chalk resistance, and weathering resistance are required. Exterior coating for low infra-red reflectivity. |
| BMS-10-60, Boeing Material Specification, Protective Enamel. | Exterior decorative paint system. Protective urethane topcoat |
| MIL-PRF-23236** (Ships), "Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast (Class 4)." | Steel ship tanks, fuel, and salt water ballast. |
| NFGS-09970*** | Protective linings for petroleum fuels. |
| MIL-C-46168A (NR), "Coating: Aliphatic Polyurethane, Chemical Agent Resistant." | Exterior coating for military combat vehicles. |

* MIL-PRF-85285 has replaced MIL-P-85285 and MIL-P-83286 which have been canceled.
** Formerly MIL-P-23236 or DoD-P-23236 which have been canceled.
*** NavDocks 47Y6 was changed to NFGS-09872B, which was canceled. Use NFGS-09970.

- Users of respirators must be properly trained in their use.
- Always be sure the respirator is in good working order.
- Know its limitations.
- Be sure it fits properly. Clean it after each use.

Respirator manufacturers may be helpful in developing a good respirator program.

In addition to respirators, other forms of recommended personal protective equipment include safety glasses or goggles. Nevertheless, should spray mist get into the eye, rinse immediately and sufficiently with lukewarm water and consult an eye doctor should irritation persist.

Regarding skin contact, it is suggested that as much of the exposed skin area as possible be covered with clothing or skin creams. Cured coating cannot be removed easily. Application of a protective skin cream to the hands prior to start of work will facilitate the soap and water removal of paint splashes or overspray. Skin areas covered only by protective creams should be kept to an absolute minimum. Aggressive solvents are unsuitable for skin cleaning as they wash oils out of the skin and can cause secondary reactions.

## 9. Disclaimer

**9.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

## 10. Notes

Notes are not a requirement of this specification.

Provided by : www.spic.ir Licensee: NISOC Library

**10.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**10.2** Table 1 offers suggested areas of usage for urethane coatings. However, the coating supplier should be consulted for specific recommendations and resistances.

**10.3** Table 2 is a listing of typical urethane specifications and their end-use applications. This listing includes both one and two-component coatings used as primers, intermediates, and topcoats.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS 18.01
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM NO. 18.01

## Three-Coat Latex Painting System

### 1. Scope

**1.1** This specification covers a complete latex painting system for structural steel.

**1.2** This system is suitable for use on parts or structures exposed in Environmental Zones 1A (interior, normally dry), and 1B (exterior, normally dry), and high humidity or mild chemical atmospheres.

**1.3** The finish paint is semi-gloss, chalk resistant, and allows for a choice of colors.

### 2. Description

**2.1** This painting system consists of surface preparation by commercial blast, two coats of latex primer, and one latex semi-gloss finish coat.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 23** | Latex Primer for Steel Surfaces |
| **Paint 24** | Latex Semigloss Exterior Topcoat |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1** SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." If specified in the procurement documents, a better degree of cleaning shall be substituted (SSPC-SP 5, "White Metal Blast Cleaning," or SSPC-SP 10, "Near-White Blast Cleaning").

### 5. Paints

**5.1 PRIMER:** SSPC-Paint 23, "Latex Primer for Steel Surfaces."

**5.2 INTERMEDIATE:** SSPC-Paint 23, "Latex Primer for Steel Surfaces," tinted to a color contrasting with the primer and the finish coat.

**5.3 FINISH COAT:** SSPC-Paint 24, "Latex Semi-Gloss Exterior Topcoat." The color must be specified.

### 6. Paint Application

**6.1 PAINT APPLICATION:** Follow the requirements SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 TOUCH-UP PAINTING:** In accordance with specification SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel" and in particular with the section thereof entitled "Field Painting."

**6.3 MAINTENANCE PAINTING:** For maintenance painting procedures, see SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems."

**6.4 NUMBER OF COATS:** Minimum of three.

**6.5 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages": primer 64 micrometers (2.5 mils); inter-

Provided by : www.spic.ir Licensee: NISOC Library

mediate coat 50 micrometers (2.0 mils); finish coat 38 micrometers (1.5 mils); for the three-coat painting system 150 micrometers (6.0 mils).

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**9.2** It is not recommended to expose steel to the weather with less than two coats of waterborne coating. Therefore, the intermediate coat should be applied before any exposure and the finish coat within three months for maximum performance of this system.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS Guide 19.00
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM GUIDE 19.00

## Guide for Selecting Painting Systems for Ship Bottoms*

### 1. Scope

**1.1** This guide covers painting systems for ship bottoms from the keel to the light load line on steel ships. The area from the light load line to the deep load line, more commonly called the boottop area, may also be coated with these systems; however, SSPC-PS Guide 20.00 covers painting systems for this area. It should be noted that boottops are rarely used with today's commercial ships, and bottom systems may extend up to the deep load line.

**1.2** These coating systems may also be used for other floating or stationary structures exposed to or submerged in salt or brackish water. This would include barges, buoys, oceanographic installations, etc.

### 2. Description

**2.1** This guide outlines the components of a complete painting system for the protection of the exterior bottoms of steel ships operating primarily in salt or brackish waters. It consists of surface preparation for both new construction and for maintenance and repair of existing ships, prime coats, or intermediate anti-corrosive coats and antifouling finishes.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 through 3.6 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **Paint 16** | Coal Tar Epoxy Polyamide Black (or Dark Red) Paint |
| **Paint 17** | Chlorinated Rubber Primer |
| **Paint 18** | Chlorinated Rubber Intermediate Coat Paint |
| **Paint 19** | Chlorinated Rubber Topcoat Paint |
| **Paint 27** | Basic Zinc Chromate – Vinyl Butyral Wash Primer |
| **PS Guide 20.00** | Guide for Selecting Painting Systems for Boottoppings |
| **PS Guide 22.00** | Guide for Selecting One-Coat Preconstruction or Prefabrication Painting Systems |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL SPECIFICATIONS AND STANDARDS:**

| | |
|---|---|
| **DoD-P-15931** | Paint, Antifouling, Vinyl (Formerly MIL-P-15931) |
| **MIL-PRF-23236** | Paint Coating Systems, Fuel and Salt Water Ballast Tanks (Formerly MIL-P-23236 or DoD-P-23236) |
| **MIL-DTL-24441** | Paint, Epoxy-Polyamide, General Specification for (Formerly MIL-P-24441) |

### 4. Surface Preparation

**4.1 NEW CONSTRUCTION:** The surface should be abrasive blast cleaned as specified in SSPC-SP 10, "Near-White Blast Cleaning." If specified in the procurement documents, a better degree of blast cleaning shall be substituted (SSPC-SP 5). If preconstruction primers are to be used the surface preparation is to be as specified in SSPC-Guide 22.00, "Guide for Selecting One-Coat Preconstruction or Prefabrication Painting Systems."

**4.2 MAINTENANCE AND REPAIR OF EXISTING SHIPS:** Immediately upon docking, the entire bottom should

Provided by : www.spic.ir Licensee: NISOC Library

be washed with fresh water at high pressure to remove marine fouling, loosely adhering paint, salt deposits, and calcareous deposits from cathodic protection. High pressure water cleaning equipment should operate at approximately 14 to 21 Mpa (2,000 to 3,000 psi) for proper removal.

COMMENT: Once the hull has been cleaned and has dried, the entire bottom should be carefully inspected for coating system breakdown. For large areas of breakdown, abrasive blasting to the degree required by the coating system is recommended. For tenaciously adhering fouling, SSPC-SP 7, "Brush-Off Blast Cleaning," may be required. SSPC-SP 7 may also be required for proper adhesion of the new coating to certain aged coatings, e.g., epoxy, etc.

## 5. Paints

A shipbottom coating system consists of anti-corrosive and/or barrier coatings overcoated with appropriate antifouling paint. The following outlines accepted coating systems, recommended number of coats, appropriate antifouling paint, and maintenance and repair procedures. Special notations and comments follow for each shipbottom coating system. Table 1 summarizes these recommendations.

**5.1 BITUMINOUS ALUMINUM PIGMENTED SYSTEM:** Aluminum flake-filled solution of various melting point bituminous resins.

COMMENT: The greatest attribute of this system is its ease of scheduling maintenance. Surface preparation is not as demanding as for epoxy, vinyl, or chlorinated rubber systems. These are single-package and can be supplied as high-build paints. As these products dry by solvent evaporation, restrictions of temperature during application are equal to both vinyl and chlorinated rubber systems. Abrasion resistance is fair.

Due to the solvent sensitivity of these systems, application of the conventional rosin-based antifoulings can be achieved at any time. The surface must be clean, dry, and free of all contaminants. In addition, conventional antifouling based on rosin modified with esterified rosins or oils may be used. These coatings are generally filled with inert extenders and cuprous oxide and are not considered scrubbable.

**5.2 VINYL SYSTEM:** After cleaning, the steel shall be pretreated with a wash primer to improve adhesion. Apply the first coat of vinyl primer as soon as practical and preferably within 24 hours after the application of the wash primer.

Application of the vinyl antifouling can be at any time provided the anti-corrosive system is clean, dry, and free of surface contaminants.

COMMENT: The greatest attribute of a vinyl anticorrosive system is the rate of cure achieved at low temperatures. They are also single-package for ease of application. As these are thermoplastic in nature, intercoat adhesion after long service times is excellent when overcoating clean, dry, aged vinyls with new vinyl systems. This property makes these systems very good for maintenance and repair.

These systems have low volume solids and require multiple coats to achieve the proper dry film thicknesses. High-build products are possible, but care must be taken to ensure that all the solvents are released prior to putting into service. Abrasion resistance is inferior to pure epoxy or flake glass epoxy or polyester systems.

**5.2.1 Wash Primer Pretreatment:** Use SSPC-Paint 27*, "Basic Zinc Chromate Vinyl Butyral Wash Primer":

COMMENT: This paint is an alcohol solution of polyvinyl butyral resin pigmented with basic zinc chromate reacted with an alcohol solution of phosphoric acid just prior to use.

**5.2.2 Vinyl Antifouling Coating:** DOD-P-15931, "Paint Antifouling, Vinyl," Formulas 121 or 129:

COMMENT: These are based on vinyl resin and rosin, filled with inert extenders and cuprous oxide. Formula 129 (Black) is less effective than Formula 121 (Red), and is normally used only on boottop areas where black color is required.

**5.3 Catalyzed Epoxy:** MIL-DTL-24441, "Paint, Epoxy Polyamide, General Specification for,":

COMMENT: These are polyamide epoxies unmodified with hydrocarbon resins, tars, or other vehicle extenders. They can be chemically cured with amine or polyamide resins. (MIL-DTL-24441 has replaced MIL-P-24441.)

For maximum performance on fast ships that are expected to see long service, unmodified epoxy will also offer excellent abrasion resistance. Generally, these are high-build products which minimize the number of coats necessary to meet thickness requirements.

Generally, epoxy systems have poor curing characteristics at temperatures below 10°C (50°F). Below this temperature, intercoat adhesion is only poor to fair with most epoxy coatings. After long-term exposure, surface preparation in the maintenance and repair of these systems must be handled under close supervision.

The first coat of vinyl antifouling should be applied while the last coat of the epoxy anticorrosive is still in the "tacky" stage of cure. To determine suitability of the epoxy coat, simply press the thumb to the epoxy coated surface. If the epoxy is firm to the touch, yet leaves a thumb print in the coating, the epoxy is ready to receive the first coat of antifouling.

**5.4 CHLORINATED RUBBER:** SSPC-Paint 17, "Chlorinated Rubber Inhibitive Primer," SSPC-Paint 18, "Chlorinated Rubber Intermediate Coat Paint," and SSPC-Paint 19, "Chlorinated Rubber Topcoat Paint," and chlorinated rubber antifouling paint:

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**RECOMMENDED SHIPBOTTOM COATING SYSTEMS**

| GENERIC CLASS OF ANTI-CORROSIVE | NO. OF COATS | DRY FILM THICKNESS | RECOMMENDED ANTIFOULING | NO. OF COATS | DRY FILM THICKNESS | MAINTENANCE AND REPAIR PROCEDURES |
|---|---|---|---|---|---|---|
| 5.1 Bituminous Aluminum Pigmented | 2 | 7.0-8.0 Mils 175-200 Micrometers | Conventional rosin-based antifouling | 2 | 3.0-4.0 Mils 75-100 Micrometers | Fresh water wash, spot blast or power tool clean bad areas. |
| 5.2 Vinyl | | | | | | |
| (A) Wash primer | 1 | (A) 0.5 Mils 13 Micrometers | Vinyl antifouling | 2 | 4 Mils 100 Micrometers | Fresh water wash, spot blast bad areas. |
| (B) Anticorrosive | 3 or 4 | (B) 4.5-6.0 Mils 114-150 Micrometers | | | | |
| 5.3 Catalyzed Epoxy | 2 or 3 | 8.0-12.0 Mils 200-300 Micrometers | Vinyl antifouling | 2 | 4 Mils 100 Micrometers | Fresh water wash, spot blast bad areas. |
| 5.4 Chlorinated Rubber | 3 | 9.0 Mils 230 Micrometers | Chlorinated rubber antifouling | 2 | 4 Mils 100 Micrometers | Fresh water wash, spot blast bad areas. |
| 5.5 Pitch Epoxy | 2 | 16.0 Mils 400 Micrometers | Vinyl antifouling | 2 | 4 Mils 100 Micrometers | Fresh water wash, spot blast bad areas, step back antifouling in areas of repair. |
| 5.6 Flakeglass Epoxy or Polyester | 1 or 2 | 25.0 Mils 635 Micrometers | Vinyl antifouling | 2 | 4 Mils 100 Micrometers | Fresh water wash, spot blast bad areas, step back antifouling in areas of repair. |

COMMENT: These single-package, generally high-build paints are applicable at very low temperatures. Chlorinated rubber systems are thermoplastic, and intercoat adhesion is excellent after long periods of service without major surface preparation.

Although volume solids are somewhat greater than those of pure vinyl systems, they are still considered low as compared to pure or modified epoxy systems. Abrasion resistance is fair.

The antifouling paints generally contain chlorinated rubber resin modified with chlorinated paraffin and rosin. They may also be filled with inert extenders and cuprous oxide or may contain an organotin antifouling agent for improvement in weed and grass control.

Application of the chlorinated rubber antifouling can be achieved at any time to the chlorinated rubber anti-corrosive system provided the surface is clean, dry, and free of surface contamination.

**5.5 COAL TAR EPOXY:** SSPC-Paint 16, "Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint," or MIL-PRF-23236, "Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast," Type 1, Class 2:

COMMENT: An epoxy resin with coal tar or other hydrocarbon modification, this paint can be chemically cured with amine or polyamide resins.

The advantages of this system are very similar to the advantages of the unmodified epoxy systems, but at a somewhat lower cost. Do not expect equal abrasion resistance with these systems.

Generally, coal tar epoxy systems have poor curing characteristics at temperatures below 10°C (50°F). In that intercoat adhesion after exposure to weather and sunlight is only poor to fair with most coal tar epoxy anti-corrosive coats, surface preparation in the maintenance and repair of these systems must be handled under close supervision. Health hazards associated with coal tar limit the use of those products containing this derivative.

The first coat of vinyl antifouling should be applied while the last coat of the pitch epoxy anticorrosive is still in the "tacky" stage of cure. To determine suitability of the pitch epoxy coat, simply press the thumb to the coated surface. If the pitch epoxy is firm to the touch, yet leaves a thumb print in the coating, it is ready to receive the first coat of antifouling.

**5.6 FLAKE GLASS EPOXY OR POLYESTER:**

COMMENT: These pure or hydrocarbon modified ep-

Provided by : www.spic.ir Licensee: NISOC Library

oxy or polyester resins are filled with hammer milled fiberglass flakes. Polyesters may contain a large percentage of styrene monomer and are cured with cobalt and peroxides. Epoxies are cured with polyamine or polyamide resins.

This system is designed for very specialized applications where the maximum abrasion resistance is required. It is generally used on keel plates, rudders, skegs, and areas of high abrasion and turbulence.

Generally, flake glass epoxy or polyester systems have poor curing characteristics at temperatures below 10°C (50°F). Because intercoat adhesion is only poor to fair with most flake glass epoxy or polyester anti-corrosives after long-term exposures, surface preparation in the maintenance and repair of these systems must be handled under close supervision.

The first coat of vinyl antifouling should be applied while the last coat of flake glass epoxy or polyester anticorrosive is still in the "tacky" stage of cure. To determine the suitability of the flake glass epoxy or polyester coat, simply press the thumb to the flake glass epoxy or polyester coated surface. If it is firm to the touch, yet leaves a thumb print in the coating, it is ready to receive the first coat of antifouling.

**5.7 PROPRIETARY COATING SYSTEMS:**

COMMENT: A proprietary coating system of the above generic types with proven performance capability may be used if desired by the specifier. Specify the manufacturer, trade name, and product number of the desired proprietary paints. The paint manufacturer should furnish a typical label analysis.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 NUMBER OF COATS:** See Table 1.

**6.3 DRY FILM THICKNESS:** Measure in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages." See Table 1.

## 7. Inspection

**7.1** All work and materials supplied under this specification is 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**9.2** Weed growth is predominant in areas reached by sunlight (from the turn of the bilge to the deep load line). It is recommended that antifouling paints which contain organotin compounds with or without cuprous oxide be used in these areas since these agents better retard weed growth.

**9.3 CATHODIC PROTECTION:** When cathodic protection is provided, the coating system selected for bottoms should be compatible with the cathodic protection system. Dielectric shields are required about and beneath all anodes used in any impressed current system to assure good current distribution. Although zinc anodes do not require dielectric shields, zinc should not be installed over a bare steel hull. Three coats of a coal tar epoxy applied to a dry film thickness of 610 micrometers (24 mils) or equivalent dielectric material are recommended for the purpose, followed by a vinyl antifouling paint. The recommended minimum length and width of the shield around the periphery of the anodes are 1.2 m (four feet) for anodes operating up to

Provided by : www.spic.ir Licensee: NISOC Library

12 volts and 1.8 m (six feet) for anodes capable of operating above 12 volts.

**9.4 FLASH POINT:** Some federal specifications require a minimum closed cup flash point of 38°C (100°F) because of possible use in confined spaces such as tanks. Lower flash points are considered acceptable for exterior application.

**9.5 EPA REGISTRATION:** The Federal Insecticide, Fungicide, and Rodenticide Act requires registration of antifouling paints, and should be so certified by the paint supplier.

* This paint contains chromate pigments. Users are urged to follow all health, safety, and environmental requirements in applying, handling or disposing of these materials.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM GUIDE NO. 20.00

## Guide for Selecting Painting Systems for Boottoppings*

### 1. Scope

**1.1** This guide covers painting systems for the protection of the exterior boottop areas (the area from the light load line to the deep load line) of steel ships. It should be noted that boottops are rarely used with today's commercial ships and bottom systems may extend up to the deep load line. In general, the anti-corrosive and antifouling paints covered in SSPC-PS Guide 19.00 are applicable to boottop areas.

### 2. Description

**2.1** This guide outlines the components of a complete painting system for the protection of the exterior boottop areas of steel ships operating primarily in salt or brackish waters. It consists of surface preparation for both new construction and for maintenance and repair of existing ships, prime coats, build or intermediate anti-corrosive coats and finishes.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 through 3.6 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **Paint 17** | Chlorinated Rubber Primer |
| **Paint 18** | Chlorinated Rubber Intermediate Coat Paint |
| **Paint 19** | Chlorinated Rubber Topcoat Paint |
| **Paint 20** | Zinc-Rich Primers (Type I - Inorganic and Type II - Organic) |
| **Paint 27*** | Basic Zinc Chromate – Vinyl Butyral Wash Primer |
| **Paint 29** | Zinc Dust Sacrificial Primer, Performance-Based |
| **PS Guide 19.00** | Guide for Selecting Painting Systems for Ship Bottoms |
| **PS Guide 22.00** | Guide for Selecting One-Coat Preconstruction or Prefabrication Painting Systems |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL SPECIFICATIONS AND STANDARDS:**

| | |
|---|---|
| **MIL-PRF-23236** | Paint Coating Systems, Fuel and Salt Water Ballast Tanks (Formerly MIL-P-23236 or DoD-P-23236) |
| **MIL-DTL-24441** | Paint, Epoxy Polyamide, General Specification for (Formerly MIL-P-24441) |

### 4. Surface Preparation

**4.1 NEW CONSTRUCTION:** The surface should be abrasive blast cleaned as specified in SSPC-SP 10, "Near-White Blast Cleaning." If specified in the procurement documents, a better degree of blast cleaning shall be substituted (SSPC-SP 5). If preconstruction primers are to be used, refer to SSPC-Guide 22.00, "Guide for Selecting One-Coat Preconstruction or Pre-Fabrication Painting Systems."

**4.2 MAINTENANCE AND REPAIR OF EXISTING SHIPS:** Immediately upon docking, the entire boottop area should be washed with fresh water at high pressure to remove marine fouling, loosely adhering paint, salt deposits, and calcareous deposits from cathodic protection. High pressure water cleaning equipment should operate at approximately 14 to 21 Mpa (2,000 to 3,000 psi) for proper removal.

COMMENT: Once the hull has been cleaned and has dried, the entire boottop area should be carefully inspected

Provided by : www.spic.ir Licensee: NISOC Library

for coating system breakdown. For large areas of breakdown, abrasive blasting to the degree required by the coating system is recommended. For tenaciously adhering fouling, SSPC-SP 7, "Brush-Off Blast Cleaning," may be required. SSPC-SP 7 may also be required for proper adhesion of the new coating to certain aged coatings, e.g., epoxy, etc.

## 5. Paints

A boottop coating system consists of anti-corrosive and/or barrier coatings overcoated with appropriate finish coats. The following outlines accepted coating systems, recommended number of coats, appropriate antifouling paint, and maintenance and repair procedures. Special notations and comments follow for each boottop coating system. Table 1 summarizes these recommendations.

COMMENT: For boottop areas which see only partial immersion or no immersion service, the following systems are appropriate. Finishing can be done with either an appropriate antifouling paint or other finish, depending on service. Special consideration should be given to the use of organo-tin antifouling coatings, as they offer the greatest potential to eliminate weed growth. For boottop coatings that are in continuous immersion service, use the coating systems recommended in SSPC-PS Guide 19.00, "Guide for Selecting Painting Systems for Ship Bottoms."

An inorganic zinc silicate coating described in Section 5.1 is the preferred primer coat for boottop coating systems described in Sections 5.2 through 5.7. If an inorganic zinc silicate primer is not used, an additional coat should be added to the systems as the first coat. The coating should be an acceptable anti-corrosive primer, preferably of the same generic class as the intermediate or build coats.

**5.1 SSPC-PAINT 20,** "Zinc-Rich Primers (Type I, Inorganic and Type II, Organic)," and MIL-PRF-23236, "Paint Coating System, Steel Ship Tank, Fuel and Salt Water Ballast," Type I, "General Use," Class 3, "Silicate, Phosphate, or Silicone Zinc" (See Note 9.2):

COMMENT: Of all anti-corrosive coatings, inorganic zinc silicates alone provide cathodic protection. Inorganic silicate vehicles may contain some organic modifications, but these modifications should not exceed 30 percent of the total binder composition. The cured binder should contain at least 70 percent silicate, calculated as silicone dioxide. As there are many levels and types of pigmentation, including zinc metal and extenders, the coatings supplier should supply specific performance data.

For partially immersed or non-immersed areas, the preferred base coat is a single coat of an inorganic zinc silicate applied at a dry film thickness of 63 to 88 micrometers (2.5 to 3.5 mils).

Inorganic zinc silicates should not be used below the flakeglass epoxy or polyester coating system described in Section 5.3 as the silicate coating may interfere with the effectiveness of these highly abrasion resistant coatings.

For the application of a complete new coating of inorganic zinc during the maintenance and repair of existing ships, the surface should be abrasive blast cleaned as specified in SSPC-SP 1O, "Near-White Blast Cleaning."

**5.2 CATALYZED EPOXY:** MIL-DTL-24441, "Paint, Epoxy Polyamide, General Specification for,":

COMMENT: These are polyamide epoxies unmodified with hydrocarbon resins, tars, or other vehicle extenders. They can be chemically cured with amine or polyamide resins. (MIL-DTL-24441 has replaced MIL-P-24441.)

For maximum performance on fast ships that are expected to see long service, unmodified epoxy will also offer excellent abrasion resistance. Generally, these are high-build products which minimize the number of coats necessary to meet thickness requirements.

Generally, epoxy systems have poor curing characteristics at temperatures below 10°C (50°F). Below this temperature, intercoat adhesion is only poor to fair with most epoxy coatings; after long-term exposure, surface preparation in the maintenance and repair of these systems must be handled under close supervision.

**5.3 FLAKE GLASS EPOXY OR POLYESTER:**

COMMENT: These pure or hydrocarbon modified epoxy or polyester resins are filled with hammer milled fiberglass flakes. Polyesters may contain a large percentage of styrene monomer and are cured with cobalt and peroxides. Epoxies are cured with polyamine or polyamide resins.

This system is designed for very specialized applications where the maximum abrasion resistance is required. It is generally used on keel plates, rudders, skegs, and areas of high abrasion and turbulence.

Generally, flake glass epoxy or polyester systems have poor curing characteristics at temperatures below 10°C (50°F). Because intercoat adhesion is only poor to fair with most flake glass epoxy or polyester anti-corrosives after long-term exposures, surface preparation in the maintenance and repair of these systems must be handled under close supervision.

**5.4 VINYL SYSTEM:** After cleaning, the steel shall be pretreated with a wash primer to improve adhesion. Apply the first coat of vinyl primer as soon as practical and preferably within 24 hours after the application of the wash primer.

COMMENT: The greatest attribute of a vinyl anti-corrosive system is the rate of cure achieved at low temperatures. They are also single-package for ease of application. As these are thermoplastic in nature, intercoat adhesion after long service times is excellent when overcoating clean, dry, aged vinyls with new vinyl systems. This property makes these systems very good for maintenance and repair.

These systems have low volume solids and require

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**RECOMMENDED BOOTOP COATING SYSTEMS**

| GENERIC CLASS OF ANTI-CORROSIVE | NO. OF COATS | DRY FILM THICKNESS | FINISH COATS | NO. OF COATS | DRY FILM THICKNESS | MAINTENANCE AND REPAIR PROCEDURES |
|---|---|---|---|---|---|---|
| 5.1 Inorganic Zinc Silicate | 1 | 2.5-3.5 Mils 63-88 Micrometers | Consult Manufacturer** | | | Fresh water wash, spot blast bad areas. |
| 5.2 Catalyzed Epoxy (Amine or Polyamide Cured) | 2 | 6.0-8.0 Mils 150-200 Micrometers | Catalyzed Epoxy | 1 | 2.0-3.0 Mils 50-75 Micrometers | Fresh water wash, spot blast bad areas. |
| 5.3 Flake Glass Epoxy or Polyester | 1 or 2 | 30.0-50.0 Mils 750-1250 Micrometers | None Catalyzed Epoxy Optional | | | Fresh water wash, spot blast bad areas. |
| 5.4 Vinyl*** | 2 | 3.0-4.0 Mils 75-100 Micrometers | Vinyl, Vinyl Acrylic or Vinyl Alkyd | 1 or 2 | 2.0-3.0 Mils 50-75 Micrometers | Fresh water wash, spot blast bad areas. |
| 5.5 Vinyl Acrylic*** | 2 | 3.0-4.0 Mils 75-100 Micrometers | Vinyl Acrylic | 1 or 2 | 2.0-3.0 Mils 50-75 Micrometers | Fresh water wash, spot blast bad areas. |
| 5.6 Chlorinated Rubber** | 2 | 6.0 Mils 150 Micrometers | Chlorinated Rubber | 1 | 2.0 Mils 50 Micrometers | Fresh water wash, spot blast bad areas. |
| 5.7 Alkyd** | 2 | 4.0 Mils 100 Micrometers | Alkyd | 1 or 2 | 2.0-4.0 Mils 50-100 Micrometers | Fresh water wash, spot blast bad areas. |

** If an inorganic zinc silicate base coat is used, it will be necessary to apply an appropriate tie coat primer. Check with the coatings supplier for more specific information and recommendations on overcoating procedures.
***If no inorganic zinc silicate is used, a wash primer pretreatment applied to a dry film thickness of approximately 13 micrometers (0.5 mil) may be required with some vinyl or vinyl acrylic systems. Apply wash primer as soon as practical after cleaning and first coat of vinyl or vinyl acrylic as soon as practical, (preferable within 24 hours of the applicaiton of wash primer).

multiple coats to achieve the proper dry film thicknesses. High-build produces are possible, but care must be taken to ensure that all the solvents are released prior to putting into service. Abrasion resistance is inferior to pure epoxy or flake glass epoxy or polyester systems.

**5.4.1 Wash Primer Pretreatment: Use SSPC-Paint 27*, "Basic Zinc Chromate—Vinyl Butyral Wash Primer":**

COMMENT: This paint is an alcohol solution of polyvinyl butyral resin pigmented with basic zinc chromate reacted with an alcohol solution of phosphoric acid just prior to use.

**5.5 VINYL-ACRYLIC (VINYL-ALKYD):**

COMMENT: Vinyl-acrylic paints are a mixture of vinyl and acrylic resins plasticized with the same ester type plasticizers used in unmodified vinyls. Vinyl-alkyd paints are vinyl resins modified with long and medium long oil alkyd resins and plasticized in the same way as unmodified vinyls. The vinyl-alkyds are used only as finish coats.

Unlike the vinyl anti-corrosive systems, vinyl-acrylic base coat primers generally do not need a wash primer.

The greatest attribute of a vinyl-acrylic anti-corrosive system is the rate of cure achieved at low temperatures. They are also single-package for ease of application. As these are thermoplastic in nature, intercoat adhesion after long service times is maximized for maintenance and repair. In general, vinyl-acrylic finishes will offer substantially better gloss than vinyl systems.

These systems have low volume solids and require multiple coats to achieve the proper dry film thicknesses. High-build products are possible, but care must be taken to ensure that all the solvents are released prior to putting into service. Abrasion resistance is inferior to pure epoxy or flake glass epoxy or polyester systems.

Provided by : www.spic.ir Licensee: NISOC Library

**5.6 CHLORINATED RUBBER:** SSPC-Paint 17, "Chlorinated Rubber Inhibitive Primer," SSPC-Paint 18, "Chlorinated Rubber Intermediate Coat Paint," and SSPC-Paint 19, "Chlorinated Rubber Topcoat Paint":

COMMENT: These paints generally contain chlorinated rubber resin modified with chlorinated paraffin and rosin. They may also contain hydrocarbon resin modifications. They may also be filled with inert extenders.

These single-package, generally high-build paints are applicable at very low temperatures. Chlorinated rubber systems are thermoplastic, and intercoat adhesion is excellent after long periods of service without major surface preparation.

Although volume solids are somewhat greater the those of vinyl systems, they are still considered low a compared to epoxy systems. Abrasion resistance is fair.

**5.7 ALKYD:**

COMMENT: Alkyd resins are prepared from various oils or the fatty acids of those oils and an anhydride and polyhydric alcohol. Primers generally contain inhibitive pigments.

The greatest attribute of this system is its low cost as compared to any of the above. Surface preparation is generally not as demanding as that for epoxy, vinyl, and chlorinated rubber systems.

Conventional alkyd or oleoresinous coatings cure by solvent release and metal catalyzed crosslinking. Cure below 10°C (50°F) is poor. Volume solids are generally 10 to 20 percent higher than those for vinyl and chlorinated coatings, but high build alkyds are not recommended. Because of poor low temperature curing, application as related to film thickness can be critical. Abrasion resistance is only fair.

**5.8 PROPRIETARY COATING SYSTEMS:**

COMMENT: A proprietary coating system of the above generic types with proven performance capability may be used if desired by the specifier. Specify the manufacturer, trade name, and product number of the desired proprietary paints. The paint manufacturer should furnish a typical label analysis.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 NUMBER OF COATS:** See Table 1.

**6.3 DRY FILM THICKNESS:** Measure in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages." See Table 1.

## 7. Inspection

**7.1** All work and materials supplied under this specification is 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**9.2** Coatings conforming to SSPC-Paint 29, "Zinc Dust Sacrificial Primer, Performance-Based" may also satisfy the requirements of this Guide.

**9.3** The paints specified herein may not comply with some air pollution regulations because of their solvent content.

Provided by : www.spic.ir Licensee: NISOC Library

* This paint contains chromate pigments. Users are urged to follow all health, safety, and environmental requirements in applying, handling or disposing of these materials.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PS Guide 21.00
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM GUIDE 21.00

## Guide for Selecting Painting Systems for Topsides*

### 1. Scope

**1.1** This guide covers painting systems for the protection of the topside or exterior area of steel ships. This includes the area from the deep load line to the rail, more commonly called the freeboard, decks, and superstructure.

These systems can also be used for above-water parts of floating structures exposed to salt or fresh water and the normal marine environment. They also cover all above-water areas on ships such as deck equipment or machinery, booms, mast, and bulwarks.

### 2. Description

**2.1** This guide outlines the components of a complete painting system for the protection of the exterior topside areas of steel ships operating primarily in salt or brackish waters. It consists of surface preparation for both new construction and for maintenance and repair of existing ships, prime coats, build or intermediate anti-corrosive coats, and finishes.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 through 3.6 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **Paint 17** | Chlorinated Rubber Primer |
| **Paint 18** | Chlorinated Rubber Intermediate Coat Paint |
| **Paint 19** | Chlorinated Rubber Topcoat Paint |
| **Paint 21** | White or Colored Silicone Alkyd Paint |
| **Paint 27*** | Basic Zinc Chromate – Vinyl Butyral Wash Primer |
| **PS Guide 22.00** | Guide for Selecting One-Coat Preconstruction or Prefabrication Painting Systems |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL SPECIFICATIONS AND STANDARDS:**

| | |
|---|---|
| **MIL-PRF-23236** | Paint Coating Systems, Fuel and Salt Water Ballast Tanks (Formerly MIL-P-23236 or DoD-P-23236) |
| **MIL-DTL-24441** | Paint, Epoxy Polyamide, General Specification for (Formerly MIL-P-24441) |

### 4. Surface Preparation

**4.1 NEW CONSTRUCTION:** The surface should be abrasive blast cleaned as specified in SSPC-SP 10, “Near-White Blast Cleaning.” If specified in the procurement documents, a better degree of blast cleaning shall be substituted (SSPC-SP 5). If preconstruction primers are to be used, refer to SSPC-PS Guide 22.00, “Guide for Selecting One-Coat Preconstruction or Prefabrication Painting Systems.”

**4.2 MAINTENANCE AND REPAIR OF EXISTING SHIPS:** All areas to be coated should be dry and free of all surface contaminants such as loose paint, oil, and grease. For large areas of coating breakdown, abrasive blast cleaning as specified in SSPC-SP 6, “Commercial Blast Cleaning” is recommended.

### 5. Paints

A topside coating system consists of anti-corrosive and/or barrier coatings overcoated with appropriate finish

Provided by : www.spic.ir Licensee: NISOC Library

coats. The following outlines accepted coating systems, recommended number of coats, and maintenance and repair procedures. Special notations and comments follow for each topside coating system. Table 1 summarizes these recommendations.

COMMENT: For topside areas which see only partial immersion or no immersion service, the following systems are appropriate. The choice of coating system depends upon service use and expected life of the system needed.

For partially immersed or non-immersed areas, the preferred base coat is a single coat of an inorganic zinc silicate applied at a dry film thickness of 63 to 88 micrometers (2.5 to 3.5 mils).

For the application of a complete new coating of inorganic zinc primer during the maintenance and repair of existing ships, the surface should be abrasive blast cleaned as specified in SSPC-SP 10, "Near-White Metal Blast Cleaning."

If an inorganic zinc silicate primer is used, one intermediate coat may be omitted from the system. The coating should be an acceptable anti-corrosive primer, preferably of the same generic class as the intermediate or build coats.

**5.1 CATALYZED EPOXY:** MIL-P-24441, "Paint, Epoxy Polyamide, General Specification for":

COMMENT: These are polyamide epoxies unmodified with hydrocarbon resins, tars, or other vehicle extenders. They can be chemically cured with amine or polyamide resins. (MIL-P-24441 has been replaced with MIL-DTL-24441.)

For maximum performance on fast ships that are expected to see long service, pure epoxy will also offer excellent abrasion resistance. Generally, these are high-build products which minimize the number of coats necessary to meet thickness requirements.

Generally, epoxy systems have poor curing characteristics at temperatures below 10°C (50°F). Below this temperature, intercoat adhesion is only poor to fair with most epoxy coatings; after long-term exposure, surface preparation in the maintenance and repair of these systems must be handled under close supervision.

For decorative purposes, a single coat of two part polyurethane (aliphatic type) or vinyl acrylic may be used to replace the finish coat of unmodified epoxy. Epoxies tend to chalk quite heavily.

**5.2 VINYL SYSTEM:** After cleaning, the steel shall be pretreated with a wash primer to improve adhesion. Apply the first coat of vinyl primer as soon as practical and preferably within 24 hours after the application of the wash primer.

COMMENT: The greatest attribute of a vinyl anti-corrosive system is the rate of cure achieved at low temperatures. They are also single-package for ease of application. As these are thermoplastic in nature, intercoat adhesion after long service times is excellent when overcoating clean, dry, aged vinyls with new vinyl systems. This property makes these systems very good for maintenance and repair.

These systems have low volume solids and require multiple coats to achieve the proper dry film thicknesses. High-build products are possible, but care must be taken to ensure that all the solvents are released prior to putting into service. Abrasion resistance is inferior to pure epoxy or flake glass epoxy, or polyester systems.

**5.2.1 Wash Primer Pretreatment:** Use SSPC-Paint 27*, "Basic Zinc Chromate—Vinyl Butyral Wash Primer,":

COMMENT: This paint is an alcohol solution of polyvinyl butyral resin pigmented with basic zinc chromate reacted with an alcohol solution of phosphoric acid just prior to use.

**5.3 VINYL-ACRYLIC (VINYL-ALKYD):**

COMMENT: Vinyl-acrylic paints are a mixture of vinyl and acrylic resins plasticized with the same ester type plasticizers used in unmodified vinyls. Vinyl-alkyd paints are vinyl resins modified with long and medium long oil alkyd resins and plasticized in the same way as unmodified vinyls. The vinyl alkyds are used only as finish coats.

Unlike the vinyl anti-corrosive systems, vinyl-acrylic base coat primers generally do not need a wash primer.

The greatest attribute of a vinyl-acrylic anti-corrosive system is the rate of cure achieved at low temperatures. They are also single-package for ease of application. As these are thermoplastic in nature, intercoat adhesion after long service is maximized for maintenance and repair. In general, vinyl-acrylic finishes will offer substantially better gloss than vinyl systems.

These systems have low volume solids and require multiple coats to achieve the proper dry film thicknesses. High-build products are possible, but care must be taken to ensure that all the solvents are released prior to putting into service. Abrasion resistance is inferior to epoxy or flake glass epoxy or polyester systems.

**5.4 CHLORINATED RUBBER:** SSPC-Paint 17, "Chlorinated Rubber Inhibitive Primer," SSPC-Paint 18, "Chlorinated Rubber Intermediate Coat Paint,'' and SSPC-Paint 19, "Chlorinated Rubber Topcoat Paint":

COMMENT: These paints generally contain chlorinated rubber resin modified with chlorinated paraffin. They may also contain hydrocarbon resin modifications. They may also be filled with inert extenders.

These single-package, generally high-build paints are applicable at very low temperatures. Chlorinated rubber systems are thermoplastic, and inter-coat adhesion is excellent after long periods of service without major surface preparation.

Although volume solids are somewhat greater than those of vinyl systems, they are still considered low as compared to epoxy systems. Abrasion resistance is fair.

Provided by : www.spic.ir Licensee: NISOC Library

**5.5 ALKYD:**

COMMENT: Based on short, medium, and long oil alkyds depending upon properties desired. Base coat primers generally contain rust inhibitive pigments. Finishes may be gloss, semi-gloss, or flat depending upon areas of usage and appearance needed. May be pigmented with inorganic or organic pigments for color, provided light stability is afforded.

If an inorganic zinc silicate coating is used as the primer, then a tie-coat compatible with both coating types must be applied before any alkyd coatings.

The greatest attribute of this system is its low cost and ease of application as compared to any of the above. Surface preparation is generally not as demanding as that for epoxy, vinyl, and chlorinated rubber systems. These are single package and can be supplied as high build paints. Heavy films of primers should be avoided in maintenance work.

Conventional alkyd or oleoresinous coatings cure by solvent release and oxidation. Cure below 10°C (50°F) is poor. Volume solids are generally 10 to 20 percent higher than those for vinyl and chlorinated coatings, but high build alkyds are not recommended. Because of poor low temperature curing, application as related to film thickness can be critical. Abrasion resistance is only fair.

**5.6 SILICONE ALKYD:** SSPC Paint 21, "White or Colored Silicone Alkyd Paint" (Type I, "High Gloss" and Type II, "Medium Gloss"):

COMMENT: Silicone alkyd paints use the same primers as alkyd paints with similar surface preparation. Gloss is usually high or medium to maximize long-term weatherability.

Although initial cost is higher than alkyd paints, silicone alkyds retain initial gloss and are more chalk resistant.

Like alkyds, silicone alkyds cure by solvent evaporation and oxidation. Cure below 10°C (50°F) is poor. Volume solids are generally 10 to 20 percent higher than those for vinyl and chlorinated rubber coatings, but high build alkyds are not recommended. Abrasion resistance and chemical resistance properties are equal to alkyd paints.

**5.7 PROPRIETARY COATING SYSTEMS:**

COMMENT: A proprietary coating system of the above generic types with proven performance capability may be used if desired by the specifier. Specify the manufacturer, trade name, and product number of the desired proprietary paints. The paint manufacturer should furnish a typical label analysis.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 NUMBER OF COATS:** See Table 1.

**6.3 DRY FILM THICKNESS:** Measure in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages." See Table 1.

## 7. Inspection

**7.1** All work and materials supplied under this specification is 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**RECOMMENDED TOPSIDE COATING SYSTEMS**

| GENERIC CLASS OF ANTICORROSIVE | NO. OF COATS | DRY FILM THICKNESS | APPROPRIATE THICKNESS | NO. OF COATS | DRY FILM THICKNESS | MAINTENANCE AND REPAIR PROCEDURES |
|---|---|---|---|---|---|---|
| 5.1 Catalyzed Epoxy | 1 or 2 | 2.0-4.0 Mils 50-100 Micrometers | Catalyzed Epoxy | 1 | 4.0-6.0 Mils 100-150 Micrometers | Fresh water wash, spot blast bad areas. |
| 5.2 Vinyl | | | | | | |
| (A) Wash Primer | 1 | (A) 0.5 Mils 13 Micrometers | Vinyl Alkyd or Vinyl Acrylic | 1 or 2 | 2.5 Mils 64-75 Micrometers | Fresh water wash, spot blast bad areas. |
| (B) Anti-Corrosive | 3 | (B) 4.5-6.0 Mils 114-150 Micrometers | | | | |
| 5.3 Vinyl Acrylic (A) Primer | 1 | (A) 2.0-2.5 Mils 50-64 Micrometers | Vinyl Acrylic | 1 or 2 | 1.5-3.0 Mils 38-75 Micrometers | Fresh water wash, spot blast bad areas. |
| (B) Intermediate | 2 | (B) 4.0-6.0 Mils 100-150 Micrometers | | | | |
| 5.4 Chlorinated Rubber | 3 | 9.0 Mils 225 Micrometers | Chlorinated Rubber | 1 | 1.0-1.5 Mils 25-38 Micrometers | Fresh water wash, spot blast bad areas. |
| 5.5 Alkyd | 2 | 3.0-4.0 Mils 75-100 Micrometers | Alkyd or Silicone Alkyd | 2 | 3.0-4.0 Mils 75-100 Micrometers | Fresh water wash, spot blast bad areas. |
| or | | | | | | |
| 5.6 Silicone Alkyd | | | | | | |

* This paint contains chromate pigments. Users are urged to follow all health, safety, and environmental requirements in applying, handling, or disposing of these materials.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINTING SYSTEM GUIDE 22.00

## Guide for Selecting One-Coat Preconstruction or Prefabrication Painting Systems

### 1. Scope

**1.1** This guide covers those shop primers used in today's modern commercial shipyards for preconstruction and prefabrication priming of abrasive blast cleaned structural steel and steel plates. To maximize efficiency in new construction, all ships' steel plates, shapes, and angles are abrasive blast cleaned, shop primed, and stored for future use in preparation of sections of ships, called modules or units. Shop primers are covered by generic classification.

COMMENT: Automatic abrasive blast cleaning and coating with preconstruction primer is common practice in shipbuilding today. The reason for the popularity of this practice is the reduction of costly hand abrasive blasting after unit or module construction. Some of the attributes of good preconstruction primers include:

- Weldability with minimal effect on weld integrity;
- Adequate corrosion protection for the steel prior to overcoating;
- Compatibility with topcoats to be used;
- Ability to be applied in thin films using automatic spray equipment;
- Minimum health hazard when burning, cutting, and welding through the primer;
- Drying to handle in 4 to 7 minutes to minimize damage from rollers and cranes.

### 2. Description

**2.1** Generally, there are two classifications of preconstruction primers, organic resin based primers and inorganic silicate based primers. Within these two classes many variations and modifications exist. Primers for use in the shipyard must be very carefully evaluated and close consideration given to the characteristics of the products which are important to the individual shipyard's production procedures.

### 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Section 3.4 and 3.5 and form a part of the specification.

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

**3.3** 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.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

### 4. Surface Preparation

**4.1** The surface should be abrasive blast cleaned as specified in SSPC-SP 10, "Near-White Blast Cleaning."

COMMENT: It should be noted that the surface profile of the steel after cleaning is extremely important in preconstruction priming. As the thickness of these products is quite low in comparison to the thickness of the final coating system, the surface profile must be carefully controlled. In general, a profile of 1.0 to 1.5 mils (25 to 38 micrometers) is appropriate for most applications.

### 5. Paints

The following outlines acceptable preconstruction primers. Special notations and comments follow each type of primer. Table 1 summarizes these recommendations.

COMMENT: Before a preconstruction primer can be chosen for any facility, several aspects of the shipyard's requirements and production procedures must be taken into consideration. The prime objective in using a preconstruction primer is to afford steel corrosion protection of plates and shapes during fabrication and unit storage prior to overcoating. This storage period ranges from three months to several years.

Consideration of which preconstruction primer is best suited should be a result of extensive testing at the individual shipyard as well as discussions with coatings suppli-

Provided by : www.spic.ir Licensee: NISOC Library

ers. The extensive testing performed should include corrosion resistance, topcoat compatibility, applicability at required thickness, welding and burning characteristics, toxicity and safety characteristics, and drying characteristics. Other properties which should be investigated before final selection is made include cost per gallon (including any thinning requirements), volume solids content, and whether the material is a single- or two-package product.

In determining the cost per gallon of these types of products, care should be exercised that the calculation is based on the film thickness required at the length of corrosion protection afforded (including thinning requirements), so that true cost comparisons can be made.

**5.1 INORGANIC ZINC SILICATES:**

COMMENT: Generally, inorganic zinc silicate coatings offer the maximum corrosion protection at the lowest film thickness because of the sacrificial characteristics of the metallic zinc. Because they are inorganic, they usually do not adversely affect welding and burning as greatly as the organic primers do. This is partly due to the higher film thickness required for equivalent corrosion protection for organic primers and partly due to the high vaporization temperature of the inorganic primers. The single-package products offer ease of application, reduced mixing time, increased pot life, and reduced storage space. These products also have good abrasion resistance and are compatible with all topcoats with the proper surface preparation and/or with the use of a suitable tiecoat.

Because of the metallic zinc particles present in films of these coatings, porosity exists in dried films which upon exposure become filled with zinc corrosion products, grease, oil, and other foreign contaminants. An abrasive brush-off blast is usually the most effective method for removing dirt and zinc corrosion products. Heavy deposits of oil or grease can be removed with degreasing solvents. Since inorganic zinc silicate primers require moisture to further cure (hydrolysis) the silicate polymers, drying oven temperatures should not exceed 71° to 82°C (160° to 180°F).

**5.2 MODIFIED WASH PRIMERS:**

COMMENT: These are vinyl butyral phosphoric acid wash primers generally modified with phenolic resins.

These coatings have good corrosion protection combined with fast dry. They are compatible with most generic topcoats. However, whenever inorganic zinc is to be used, they must be removed by abrasive blast cleaning.

Generally these are two-package products with a limited pot life. To facilitate fast dry, most have rather low flash points. Low volume solids require maximum ventilation. Check the decomposition products of these coatings before welding, burning, or cutting.

**5.3 CATALYZED EPOXY:**

COMMENT: May be amine or polyamide cured. May be modified with other resins. May contain zinc metal. Has good corrosion resistance. Can be formulated for fast dry, but ovens will be needed for thorough cure.

These coatings are two package and have a limited pot life. They are not generally used in automatic application equipment due to their slow cure characteristics. Low flash solvents are required for fast drying. If zinc metal is used, the zinc corrosion products should be removed prior to topcoating. Topcoat compatibility and decomposition products should be evaluated.

**5.4 HIGH MOLECULAR WEIGHT EPOXY:**

COMMENT: These paints generally are based on either singular epoxy resins or modified with other phenolic or hydrocarbon resins.

These are single package, generally easily applied, fast drying coatings with good corrosion resistance. These coatings are compatible with most generic topcoats; however, wherever inorganic zinc is to be used, they must be removed by abrasive blast cleaning.

To facilitate fast drying, these coatings have low flash solvents. Overcoatability should be checked with the coating supplier. Check decomposition products before welding, burning, or cutting. Solvent sensitivity may limit topcoat selection.

**5.5 ALKYD:**

COMMENT: This coating may be modified to facilitate harder films and faster dry. It is single package and easy to apply. Heat is usually required even with the quick drying types.

These materials are solvent sensitive and are not compatible with most high performance marine coatings. They must be removed by abrasive blast cleaning before subsequent coatings are applied.

**5.6 PROPRIETARY COATING SYSTEMS:**

COMMENT: A proprietary coating system of the above generic types with proven performance capability may be used if desired by the specifier. Specify the manufacturer, trade name, and product number of the desired proprietary paints. The paint manufacturer should furnish a typical label analysis.

## 6. Paint Application

**6.1 PAINT APPLICATION:** Follow requirements SSPC-PA 1, “Shop, Field, and Maintenance Painting of Steel.”

**6.2 NUMBER OF COATS:** One.

**6.3 DRY FILM THICKNESS:** Measure in accordance with SSPC-PA 2, “Measurement of Dry Coating Thickness with Magnetic Gages.” The dry film thickness should be as follows for each coating type discussed in Section 5:

Provided by : www.spic.ir Licensee: NISOC Library

| Primer | mils | micrometers |
|---|---|---|
| Inorganic Zinc Silicate | 0.6 to 1.0 | 15 to 25 |
| Modified Wash Primers | 1.0 to 1.5 | 25 to 38 |
| Catalyzed Epoxies | 1.0 to 1.5 | 25 to 38 |
| High Molecular Weight Epoxies | 1.0 to 1.5 | 25 to 38 |
| Alkyds | 1.5 to 2.0 | 38 to 50 |

## 7. Inspection

**7.1** All work and materials supplied under this specification are 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. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

**SSPC: The Society for Protective Coatings**

# COATING SYSTEM CS 23.00(I)

## Interim Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel

## Foreword

This SSPC Interim Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc, & Their Alloys & Composites for the Corrosion Protection of Steel is issued to meet a critical industry and government need. SSPC Interim Specifications are effective for a maximum of two years pending completion of a normal-track specification.

Thermal spray coatings (TSCs) are used extensively for the corrosion protection of steel and iron in a wide range of environments. The corrosion tests carried out by the American Welding Society[1] and the 34 and 44 year marine-atmosphere performance reports of the LaQue Center for Corrosion Technology[2,3] confirm the effectiveness of flame sprayed aluminum and zinc coatings over long periods of time in a wide range of hostile environments. The British Standards Institution code of practice for the corrosion protection of steel[4] specifies that only TSCs give protection greater than 20 years to first maintenance for the 19 industrial and marine environments considered and that only sealed, sprayed aluminum or zinc gives such protection in sea water immersion or splash zones.

This guide presents basic information for the application of quality TSCs. Annexes present additional information. The Table of Contents gives an overview of this standard and may be used to find specific information. The following flow diagram is the overview of the thermal spray coating process presented in this standard.

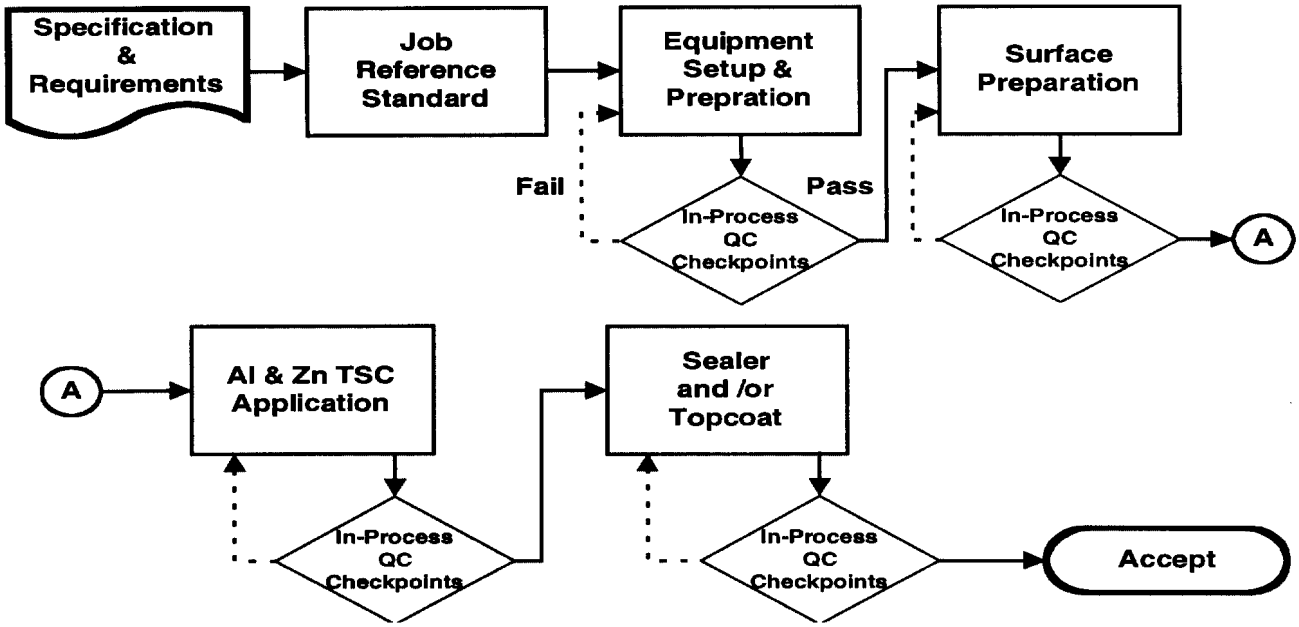
---

[1] *Corrosion Tests of Flame-Sprayed Coated Steel, 19-Year Report*, American Welding Society C2.14-74. AWS publications available from American Welding Society, P.O. Box 351040, Miami, FL 33135.

[2] R.M. Kain and E.A. Baker, *Marine Atmospheric Corrosion Museum Report on the Performance of Thermal Spray Coatings on Steel*, ASTM STP 947. ASTM publications available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

[3] S.J. Pikul, *Appearance of Thermal Sprayed Coatings after 44 Years Marine Atmospheric Exposure at Kure Beach, North Carolina*, February 1966, LaQue Center for Corrosion Technology, Inc.

[4] *Code of Practice for Protective Coatings of Iron and Steel Structures Against Corrosion*, British Standards Institution B.S. 5493: 1977. Available from American National Standards Institute, 11 West 42nd Street, New York, NY 10036.




## 1. Scope

This standard is a procedure for the application of metallic thermal spray coatings (TSC) of aluminum, zinc, and their alloys and composites for the corrosion protection of steel. Required equipment, application procedures, and in-process quality control checkpoints are specified. This standard may be used as a procurement document. Annex A presents a fill-in-the-blanks model procurement specification.

Not included in this standard are requirements for design and fabrication, thermal spray equipment qualification, coating selection, and operator and inspector certification.

This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

## 2. Description

The procedure for application of TSCs for the corrosion protection of steel includes proper (a) surface preparation of the substrate steel, (b) application of the TSC and, (c) application of the sealer or sealer and topcoat. The procedure includes use of suitable abrasive blasting, thermal spraying, sealing/topcoating, and in-process QC checkpoints.

**2.1** This standard may be used by owners and engineers to detail and contract for the application of TSCs for the preservation and maintenance of steel structures. This standard may also be used by TSC inspectors and Thermal Spray Coating Applicator (TSCA) to develop and maintain application procedures, equipment inventory, and an operator-training program.

**2.2** This standard is not meant to be an inspection standard. See SSPC 97-07 for inspection guidance.

## 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification. A standard listed here may be referenced only in the Notes, which are not requirements of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| SSPC-AB 1 | Mineral and Slag Abrasives |
| SSPC-PA 1 | Shop, Field, and Maintenance Painting |
| SSPC-PA 2 | Measurement of Dry Coating Thickness with Magnetic Gages |
| SSPC-SP 5//NACE No. 1 | White Metal Blast Cleaning |
| SSPC-SP 10/NACE No. 2 | Near-White Blast Cleaning |
| SSPC-VIS 1-89 | Visual Standard for Abrasive Blast Cleaned Steel |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| ASTM B 833 | Standard Specification for Zinc Wire for Thermal Spraying (Metallizing) |
| ASTM C 633 | Test Method for Adhesive/ Cohesive Strength of Flame Sprayed Coatings |
| ASTM D 1210 | Test Method for Fineness of Dispersion of Pigment-Vehicle Systems |
| ASTM D 4285 | Method for Indicating Oil or Water in Compressed Air |
| ASTM D 4417 | Test Method for Field Measurement of Surface Profile of Blasted Steel |
| ASTM D 4541 | Test Method for Pull-Off Strength of Coating Using Portable Adhesion Testers |
| ASTM D 4940 | Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives |

**3.6 ANSI/AWS JOINT STANDARD:**

| | |
|---|---|
| ANSI/AWS C2.18-93 | Guide for the Protection of Steel with Thermal Spray Coatings of Aluminum, Zinc, and Their Alloys & Composites |

**3.7. INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO) STANDARD:**

| | |
|---|---|
| ISO 8502-3 | Preparation of Steel Substrates Before Application of Paints and Related Products |

## 4. Terminology

**Aluminum MMC TSC:** Aluminum metal matrix composite (MMC) TSC is a coating that contains a composite material in an aluminum matrix. It is produced by flame or arc spraying a solid or cored wire that contains the composite material.

**Bend test:** The bend test (180-degree bend on a mandrel diameter based on the TSC thickness) is a qualitative test of the ductility and tensile bond of the TSC. The bend test is a macro-system test of surface preparation, equipment setup, and spray parameters and application procedures. The bend test passes if there is no cracking or spalling of the TSC material or only minor cracking visually observed on the bend-radius. The bend test fails if the coating cracks with lifting from the substrate.

**Contract pre-award validation:** The purchaser's contract pre-award evaluation of the thermal spray coating applicator (TSCA) includes (a) written procedures for and (b) demonstration of surface preparation and thermal spray materials and equipment capabilities and application process proposed for the contract work.

**Cut test:** The TSC cut test shall consist of a single cut 1.5 in. [40 mm] long through the TSC to the substrate without severely cutting into the substrate. All cuts shall be made with sharp tools. The chisel cut shall be made at shallow angle. The bond shall be considered unsatisfactory if any part of the TSC along the cut lifts from the substrate. The cutting tool shall be specified in the contract.

**Flash rusting:** Rusting that occurs on metal within minutes to a few hours after blast cleaning or other cleaning is completed. The speed with which flash rusting occurs may be indicative of soluble salt contaminants on the surface, high humidity, or both.

**Holding period:** Holding period is the time between the completion of the final anchor-tooth blasting, or final brush blasting, and the completion of the thermal spraying. There shall be no flash rusting during the holding period. The holding period, by definition, ends with onset of flash rusting.

**Job control record (JCR):** The JCR is a record form, which enumerates the essential job information and the in-process QC checkpoints required by this standard. The JCR includes information on safety precautions, and the equipment, parameters, and procedures for surface preparation, thermal spraying, and sealing. Annex B is a model JCR.

**Job reference standard (JRS):** The JRS is a job site pass/fail reference standard repre-sentative of the whole job or major sections of the job. See Section 13.2 and Figure 2.

**Topcoat:** The topcoat is a paint coat over the seal coat. Note: Paint topcoats should never be applied over an unsealed TSC.

**Sealer:** The sealer is a very thin paint coat about 1.5 mil [38 µm] thick that will be absorbed into the pores of the TSC. See Note 1.

**Soluble salt contaminants:** These water-soluble salts are inorganic com-pounds (such as chlorides and sulfates) that contaminate a product. When soluble salts are present on a prepared steel surface, they may cause flash rusting and premature coating failure.

**TSC:** thermal spray coating

**TSCA:** thermal spray coating applicator

## 5. Surface Preparation

**5.1 SURFACE FINISH:** The steel substrate shall be prepared to a white metal finish, SSPC-SP 5/NACE No. 1 for marine and immersion service or a minimum of near-white metal finish, SSPC-SP 10/NACE No. 2, for other service applications. Confirm surface finish and cleanliness per SSPC-VIS 1-89 and ASTM D 4417.

**5.2 ANGULAR PROFILE DEPTH:** The steel substrate shall have, at a minimum, an angular profile depth ≥ 2.5 mil [63 µm] with a sharp angular shape.

**5.3 ANGULAR DEPTH PROFILE MEASUREMENT SCHEDULE:** The profile depth shall be measured per ASTM D 4417, Method C (replica tape, x-coarse, 1.5-4.5 mils [38-113 µm]) or Method B (profile depth gage), or both.

**5.3.1 Manual Blasting:** At a minimum, take one profile depth measurement every 10 to 20 $ft^2$ [1-2 $m^2$] of blasted surface.

**5.3.2 Automated Blasting:** Take one profile depth measurement every 1000 to 2000 $ft^2$ [100-200 $m^2$] of blasted surface.

**5.3.3 Angular Blast Media:** Use clean dry angular blasting media. Mineral and slag abrasives shall be selected and evaluated per SSPC-AB 1. Confirm absence of oil contamination with the water sheen test per ASTM D 4940. The suitability of the angular blasting media, blasting equipment, and blasting procedures shall be validated per Section 14, Contract Pre-Award Evaluation, Demonstration and Validation.

## 6. Thermal Spray Coating (TSC) Requirements

### 6.1 FEEDSTOCK AND TSC THICKNESS

The TSC feedstock material and thickness should be selected according to intended service environment and service life. (See AWS C2.18-93, Annex B.)

1. Specify the TSC feedstock material per Annex C or ASTM B 833-93.
2. Specify the minimum and maximum TSC thickness as measured in accordance with SSPC-PA 2.

### 6.2 TSC COATING THICKNESS

**6.2.1. Thickness Less Than Contract Specification:** If upon later inspection, the TSC thickness is less than the contract requirement, then the applicator shall apply additional TSC to meet the thickness requirement. This additional thickness shall only be applied to clean and dust-free TSC without any visible substrate oxidation or rust.

1. Remove any contamination from the TSC surface or confirm the absence of contamination.
2. Oil, grease or chemical contaminants may require solvent cleaning, high-pressure water washing or more intense cleaning methods.
3. Apply additional TSC thickness to meet the contract specification.

**6.2.2. Thickness Greater Than the Contract Specification.** If the TSC thickness is greater than the contract specification, record information in the JCR and immediately notify the inspector, who in turn should notify the purchaser for resolution of this discrepancy. TSC thickness greater than 15 mils [375 μm] on exterior edges/corners, shall be removed and reapplied to the contract specified thickness.

### 6.3 TSC THICKNESS MEASUREMENT SCHEDULE

1. The TSC thickness measurement shall be made in accordance with SSPC-PA 2.
2. Use a measurement line for flat surfaces. Take the average value of 5 readings taken in line at 1 in. [2.5 cm] intervals. The line measurement will measure the peaks and valleys of the TSC.
3. Use a measurement spot for complex geometries and geometry transitions. The measurement spot should be approximately 1.6 $in.^2$ [10 $cm^2$] area. The spot measurement may not measure the peaks and valleys of the TSC.

Figure 3 illustrates the line and spot measurements.

### 6.4 TSC TENSILE BOND AND MEASUREMENT SCHEDULE

The TSC tensile bond shall be measured per ASTM D 4541 using a self-alignment adhesion tester or equivalent.

1. Specify the minimum TSC tensile bond value per Table 1. Higher values may be specified.

**Table 1 - Minimum Tensile Bond Requirements**

(Per ASTM D 4514 using self-aligning adhesion tester)

| Feedstock | psi [MPa] |
|---|---|
| Zn | 500 [3.45] |
| Al | 1000 [6.89] |
| 85/15 | 700 [4.83] |
| 90/10 $Al_2O_2$ MMC | 1000 [6.89] |

2. Make one portable tensile bond measurement about every 500 $ft^2$ [50 $m^2$]. If the tensile bond is less than the contract specification, remove the degraded TSC and reapply.
3. For non-destructive measurement: Measure tensile force to the contract-specified tensile. Then reduce the tensile force and remove the tensile fixture without damaging the TSC.

Note: The tensile-bond measurement of the portable test instrument may be related to the ASTM C 633 laboratory method in Annex D.

**6.5 BEND TEST:** The bend test (180-degree bend on a mandrel) is used as a qualitative test for proper surface preparation, equipment setup, and spray parameters. The bend test puts the thermal spray coating in tension. The mandrel diameter for the threshold of cracking depends on substrate thickness, coating thickness, and mandrel diameter.

The following table summarizes a very limited bend-test cracking threshold for arc-sprayed Zn TSC thickness on steel coupons 0.050 in [13mm] thick versus mandrel diameter.

**Table 2 – Bend Test Cracking Threshold: Mandrel Diameter vs. TSC Thickness**

**(For steel coupons 0.050 in. [13 mm] thick)**

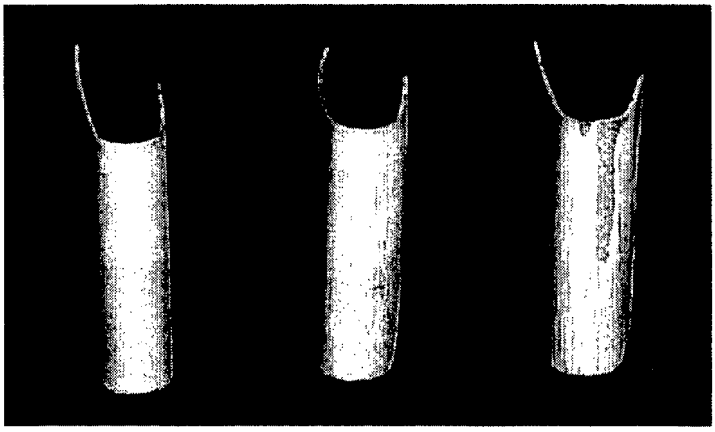
| TSC Thickness (mils) | ≥10 | ≥15 | ≥25 |
|---|---|---|---|
| Mandrel Diameter | 1/2" | 5/8" | <1"* |

* Confirm diameter with JRS

**6.5.1 Bend Test Procedure for TSC Thickness Range 7-12 mils [175-350 μm]:** Spray five corrosion-control bend coupons and pass the following bend test:

1. Use carbon steel coupons of approximate dimensions 2 x 4 to 8 x 0.050 in. [50 x 100 to 200 x 1.25 mm].
2. Prepare the surface of the coupons as required by the contract specification.
3. Spray 7-12 mils [200-250 μm] thick TSC. The TSC should be sprayed in crossing passes laying down approximately 3-4 mils [75-100 μm] per pass.
4. Bend coupons 180-degree around a 0.5 in.[13 mm] diameter mandrel.
5. Bend test passes if, on the bend-radius (see Figure 1), there is (a) no cracking or spalling or (b) only minor cracking which cannot be lifted from the substrate with a knife blade.
6, Bend test fails if the coating cracks with lifting from the substrate

**Figure 1 - TSC Bend Test: Pass and Fail Examples**




**6.6 TSC FINISH:** The deposited TSC shall be uniform without blisters, cracks, loose particles, or exposed steel as examined with a 10x loop.

**6.7 TSC POROSITY:** If required by the purchaser, specify the maximum allowable porosity and the metallographic measurement method to be used for the evaluation. Note: porosity measurements are not used for in-process quality control in metallizing for corrosion protection of steel. However, porosity measurements may be used to qualify thermal spray application process and spray parameters.

**6.8 TSC QC MEASUREMENT PROCEDURES AND INSTRUMENTS:** The suitability of the TSC thickness, portable tensile bond, bend test, and cut test measurement procedures and instruments, shall be validated during the Contract Pre-Award Validation per Section 14.

## 7. TSC Application Procedure

Annex E details the key production and quality control checkpoints for applying TSCs.

**7.1 THERMAL SPRAY EQUIPMENT SETUP:** Thermal spray equipment shall be set up, calibrated, and operated (1) per the manufacturer's instructions and technical manuals or the TSCA's refinement thereto, and (2) as validated by the JRS (see Section 13.2).

1. Spray parameters and thickness per crossing pass shall be set for spraying the specified thermal spray material and, at a minimum, be validated with the bend test.
2. The thermal spray equipment spray parameter setup shall be validated with a bend test at the beginning of each shift or crew change.
3. A copy of the spray parameters used shall be attached to the JCR.

**7.2 POST-BLASTING SUBSTRATE CONDITION AND THERMAL SPRAYING PERIOD**

**7.2.1 Steel Surface Temperature:** The steel surface temperature shall be at least 3°C [5°F] above the dew point.

**7.2.2 Holding Period:** Time between the completion of the final anchor-tooth blasting (or final brush blasting) and the completion of the thermal spraying should be no greater than six hours for steel substrates with the following exceptions:

In high humidity and damp environments, shorter holding periods shall be used. If rust bloom or a degraded coating appears at any time while spraying, stop spraying. Section 8.2.4 applies.

In low-humidity environments or in con-trolled environments with enclosed structures using industrial dehumidification equipment, it may be possible to retard the oxidation of the steel and hold the surface finish for more than six hours. The TSCA, with the concurrence of the purchaser, can establish a holding period greater than six hours by determining the acceptable temperature-humidity envelope for the work enclosure by spraying and analyzing bend coupons or tensile bond coupons, or both.

For small and movable parts, if more than 15 minutes is expected to elapse between completion of surface preparation and the start of thermal spraying, or if the part is moved to another location, the prepared surface should be protected from moisture, contamination, and finger/hand marks. Wrapping with clean ink-free paper is normally adequate.

**7.3 TSC FLASH/PRIMER COAT**

**7.3.1 Application Time:** A 1-2 mil [25-50 µm] flash/primer coat of the TSC may be applied within six hours of completing surface preparation to extend the holding period for up to four further hours beyond the complete application of the flash coat. The final TSC thickness, however, shall be applied within four hours of the completion of the application of the flash coat provided the TSC can be maintained free of contamination.

**7.3.2 Validation Procedure:** The use of a flash TSC to extend the holding period shall be validated with a tensile bond measurement or bend test, or both. Validate by:

1. Cleaning and abrasive blasting a representative job area for a portable tensile bond measurement or a bend test coupon, or both.
2. Applying a flash TSC.
3. Waiting the delay period and applying the final TSC thickness.
4. Measuring the tensile bond or performing the bend test, or both.
5. Flash TSC and holding period are acceptable if the tensile bond or bend tests, or both, are satisfactory.

## 8. TSC Application

### 8.1 PREHEAT

Preheating the starting area has been common practice in the past for flame spraying and should be continued until proven either a benefit or inconsequential. Preheat the initial 1-2 ft. [0.1-0.2 $m^3$] starting-spray area to prevent water in the flame from condensing on the substrate.

1. For flame spraying, preheat the initial starting area to approximately 250°F [120°C].
2. Validate preheating requirements with the Job Reference Standard and the bend test or tensile test, or both.

### 8.2 THERMAL SPRAYING

**8.2.1 Crossing Passes:** The specified coating thickness shall be applied in several crossing passes. The coating tensile bond strength is greater when the spray passes are kept thin. Laying down an excessively thick spray pass increases the internal stresses in the TSC and will decrease the ultimate tensile bond strength of the total TSC. Confirm the suitability of the crossing pass thickness with a bend test or tensile bond measurement, or both.

**8.2.2 Manual Spraying:** For manual spraying, use right-angle crossing passes to minimize the thin areas in the coating.

**8.2.3 Mechanized Spraying:** For mechanized spraying (mechanized movement of the gun or workpiece, or both), program overlapping and crossing passes to eliminate thin spots and stay within the coating thickness specification.

**8.2.4 Rust Bloom**: If rust bloom, blistering, or a degraded coating appears at any time during the application of the TSC or flash/ primer TSC, the following procedure applies:

1. Stop spraying.
2. Mark off the acceptable sprayed area.
3. Re-prepare the unsatisfactory areas to the required degree of surface cleanliness and surface profile, including any areas that the TSC was applied to unsatisfactory surfaces.
   a. Blast the edges of the TSC to provide for a 2-3 in. [5-7.5 cm] feathered area overlap of the new work into the existing TSC.
   b. Apply TSC to the newly prepared surfaces, and overlap the existing TSC to the extent of the feathered edge so that the overlap is a consistent thickness.

**8.2.5 TSC Thickness:** The TSC thickness shall be that specified in Section 6.1.

**8.2.6 Low Temperature Spraying:** Thermal spraying in low temperature environments (below freezing) must:

1. Meet the substrate surface temperature and holding period of Section 7.2.1 and 7.2.2. No moisture condensation on the surface is permissible during thermal spraying.
2. Be qualified with a bend test or portable tensile bond test, or both.

Note: TSCs are mechanically bonded to the substrate. Substrate preheating may be required to improve the TSC tensile bond to the substrate and reduce internal stresses.

## 9. Application of Sealers and Topcoats

Thermal sprayed steel should be sealed and/or topcoated under any of the following conditions:

- The environment is very acidic or very alkaline (normal pH range for pure zinc is 6 to 12 and for pure aluminum 4 to 11).
- The metallic coating is subject to direct attack by specific chemicals.
- A particular decorative finish is required.
- Additional abrasion resistance is required.
- Frequent salt-water spray or splash or immersion service.
- Frequent fresh water spray, or splash or immersion service, excluding potable water.

Note: Sealers and topcoats shall meet the local restrictions on volatile organic compound (VOC) content. Sealer and topcoat shall be applied per paint manufacturer's instructions for use with a TSC, or as specified by the purchaser.

**9.1 Sealer:** The seal coat shall be thin enough when applied to penetrate into the body of the TSC and seal the porosity. Added thickness to porous TSC should not be measurable. Typically the seal coat is applied at a spreading rate resulting in a theoretical 1.5 mils [38 microns] dry film thickness.

For shop and field work, sealers should be applied as soon as possible after thermal spraying and preferably within eight hours.

If sealer cannot be applied within eight hours, verify by visual inspection that the TSC has not been contaminated and is dust-free using the clear cellophane tape test (ISO 8502-3), before applying the sealer.

**9.2 Topcoat:** A topcoat is essentially a full coat of paint. Topcoats shall be chemically compatible with the sealer and shall be applied per paint manufacturer's instructions or as specified by the purchaser. Full topcoats will greatly reduce or entirely diminish the cathodic protection effects of the TSC in immersion or underground service. Do not apply a paint topcoat over an unsealed TSC.

**9.3 Applying Paints: All paint coatings shall be applied according to SSPC-PA 1, "Shop, Field and Maintenance Painting of Steel", and the paint manufacturer's recommendations for use of the product with a TSC system.**

## 10. Records

The TSCA shall use a JCR to record the TSCA's production and QC information and other information required by the purchasing contract. Additionally, the TSCA shall have its own quality assurance program. The TSCA shall keep records for a time period consistent with the TSCA's quality assurance and records program and as required for regulatory compliance and the purchasing contract. Records should be kept a minimum of one year.

## 11. Debris Containment and Control

The TSCA and the purchaser shall coordinate the specific requirements, responsibilities, and actions for the containment, collection, and removal of the debris produced by the TSCA and its sub-contractors.

## 12. Work Procedures and Safety

The purchaser shall provide its standard operating and safety procedures and compliance requirements to the TSCA. The TSCA shall follow all appropriate procedures and meet all appropriate regulatory requirements.

## 13. Documentation

**13.1 TSCA'S APPLICATION PROCEDURE:** The TSCA shall submit its application procedure proposed for the contract work. The application process shall include information on the equipment capabilities, materials, and process or application proced-ures. It shall also include in-process quality control checkpoints for surface preparation, thermal spraying, and paint work (sealer and topcoat).

**13.2 JOB REFERENCE STANDARD:** A job site pass/fail Job Reference Standard (JRS) representative of the whole job or major sections of the job shall be prepared by the TSCA. The JRS shall be used as a "comparator" to evaluate the suitability of the application process.

1. The JRS is made on a steel plate approximately 18 x 18 x 1/4 in. [46 x 46 x 0.6 cm]. See Figure 2. Note: For structural steel, the reference standard does not need to be greater than 1/4 in thick because steel will not thermally distort when TSC is applied. When actual work is less than 1/4 in thick, the JRS should be made from material of a representative thickness.

2. The JRS is made with the actual field equipment and the process parameters and procedures (surface preparation; thermal spraying; sealing or topcoating, or both; and in-process QC checkpoints) that will be used for the contracted work.
3. The JRS shall be made in representative environmental conditions spraying, with or without enclosure, as appropriate.
4. Make thickness and tensile bond measurements per Figure 4: four "5 in-line thickness measurements;" and four portable tensile bond measurements per Section 6.4. The JRS is unsatisfactory if any measurements are less than the contract-specified value.
5. The JRS is used as a pass/fail reference for the applicator's in-process QC and the purchaser's inspector.

## 14. Contract Pre-Award Evaluation, Demonstration and Validation

**14.1** The purchaser shall evaluate the suitability of the TSCA's application process submitted per 13.1.

**14.2** The purchaser, as an option for physically validating the TSCA's application process, may schedule, witness, and evaluate a contract pre-award demonstration of the TSCA's application process for the surface preparation, thermal spraying, sealing, and topcoating, using the equipment, materials, and process procedures proposed for the contract work. The JRS should be made during this demonstration and witnessed by the purchaser or his designated representative.

## 15. TSCA Warranty

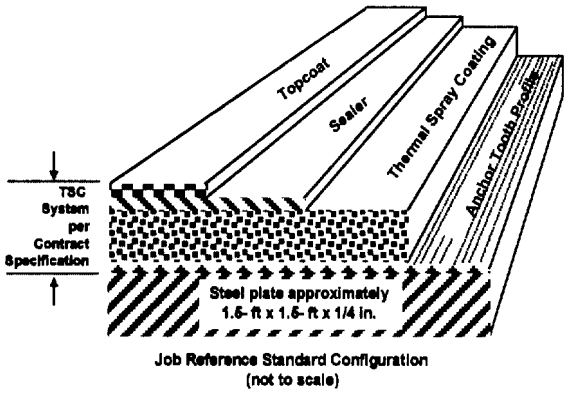
**15.1** The TSCA shall warrant the quality of its workmanship as mutually agreed to by the purchaser and the TSCA.

### 15.2 Materials Used

The TSCA shall provide the purchaser with a Certificate of Materials Used to include:

1. For angular blasting media: media type, grit size range, chemical composition, and Material Safety Data Sheet (MSDS).
2. TSC spray feedstock: alloy type/designation, lot number, wire diameter, chemical composition of the wire lot, and MSDS.
3. Sealer and topcoat: manufacturer's product and application data sheets for application on TSC system and MSDS.

**Figure 2 - Job Reference Standard**



## Notes

1. Aluminum and zinc TSCs have porosity ranging up to 15%. Interconnected porosity may extend from the surface to the substrate. Sealing extends the service life. Sealing is accomplished (a) naturally by the oxidation of the sprayed aluminum or zinc filling the pores with a tightly adherent oxide layer or (b) by applying thin paint sealer coatings that penetrate and are absorbed into the pores of the TSC. The paint seal coat should be applied before significant natural oxidation occurs. The pigment particle size for colored sealers must be small enough to flow easily into the pores of the TSC, nominally a 5-finess grind per ASTM D 1210. The paint component of the TSC system is required for additional chemical resistance. Paint materials must be compatible with the TSC material and the intended service environment. For service temperatures > 120°C [250°F], a high-temperature resistant coating such as an aluminum pigmented silicone sealer is required.

**Figure 3 - Line and spot TSC thickness measurement**

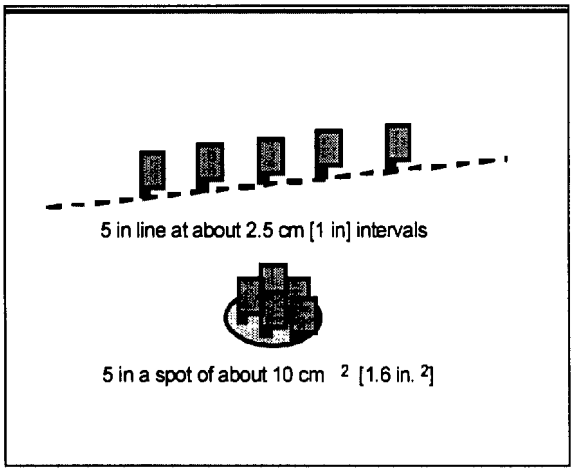
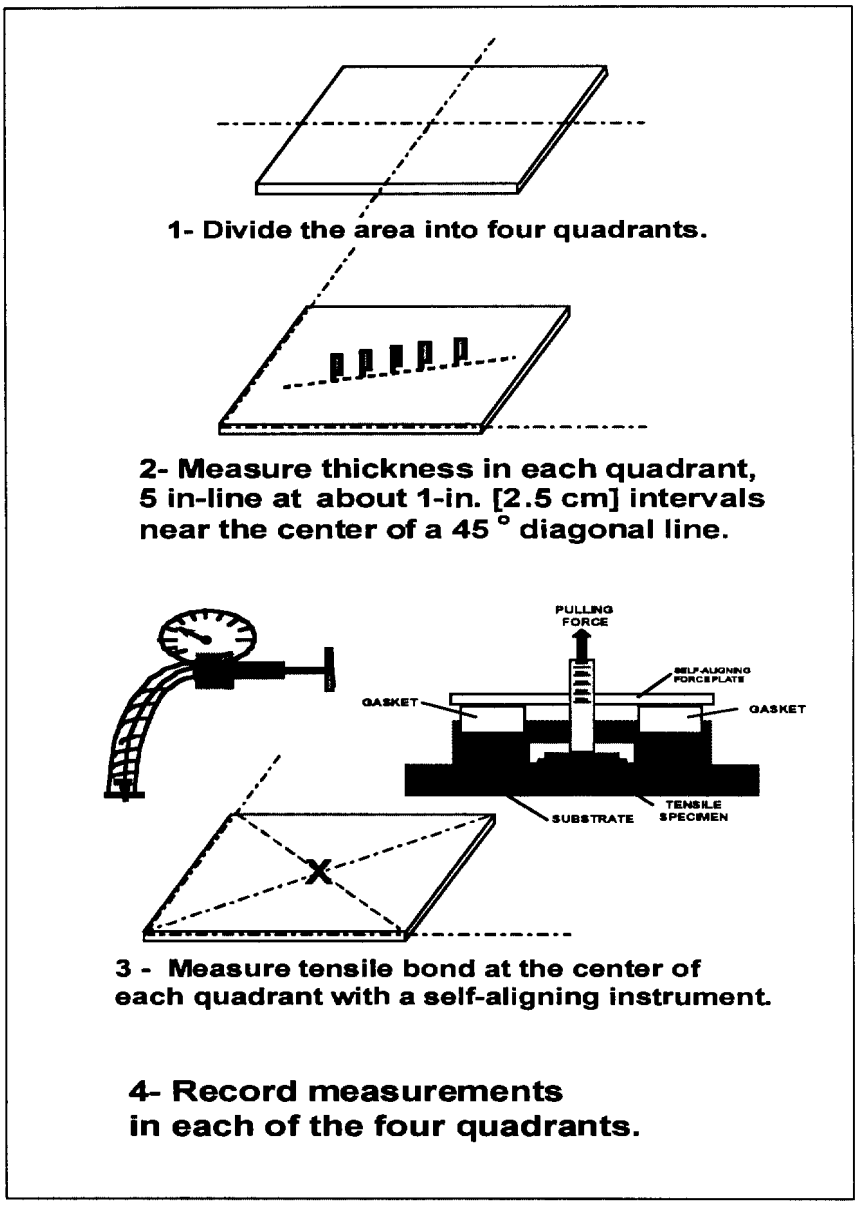


**Figure 4. Thickness and Tensile Bond Measurements for JRS Qualification**



# Annex A – Model Procurement Specification

| **The Model Specification**<br>**(Bolded text is the model specification.** *Scripted text is optional and if used, should match the format & style used in the final specification.*) | **Instructions/Rationale** |
|---|---|
| **1. Scope of Work**<br>**1.1 Application Procedure**<br>**The thermal spray coating (TSC) system (surface preparation, thermal spraying, and sealing & topcoating) shall be applied in accordance Sections 4, 5, and 6 of this specification.** | The major production and quality control (QC) steps for applying a thermal spray coating system are summarized in Annex E. Annex E should be appended to the procurement specification to inform the TSCA of the requirements. |
| **1.2 Items/Areas To Be Thermal Sprayed**<br>**Apply TSC systems to:**<br>_____<br>_____<br>_____<br>_____ | Specify the item(s) and surface(s) to be (and not to be) thermal sprayed. Reference and append engineering drawings or other technical documents that quantitatively describes the job. |
| **2. Codes & Standards**<br>**This specification takes precedence in event of conflict with cited Codes and Standards.**<br>**The following codes and standards (latest issue) apply:**<br>ASTM B 833-93, Standard Specification for Zinc Wire for Thermal Spraying (Metallizing).<br>ASTM C 633, Test Method for Adhesive/Cohesive Strength of Flame Sprayed Coatings.<br>ASTM D 1210, Test Method for Fineness of Dispersion of Pigment-Vehicle Systems.<br>ASTM D 4285, Method for Indicating Oil or Water in Compressed Air.<br>ASTM D 4417, Test Method for Field Measurement of Surface Profile of Blasted Steel.<br>ASTM D 4541, Test Method for Pull-Off Strength of Coating Using Portable Adhesion Testers.<br>ASTM D 4940, Test Method for Conductmetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives.<br>ANSI/AWS C2.18-93, Guide for the Protection of Steel with Thermal Spray Coatings of Aluminum, Zinc, and Their Alloys & Composites.<br>SSPC 97-07, The Inspection of Coatings and Linings: A Handbook for Inspectors, Owners, and Specifiers.<br>SSPC-AB 1, Mineral and Slag Abrasives.<br>SSPC-PA 2, Measurement of Dry Paint Thickness with Magnetic Gages.<br>SSPC SP-5/NACE No. 1, White-Metal Blast Cleaning.<br>SSPC-SP 10/NACE No. 2, Near-White Blast Cleaning.<br>SSPC-VIS 1-89, Visual Standard for Abrasive Blast Cleaned Steel. | List the Codes and Standards cited in this procurement specification. Add other standards as required. |

| **The Model Specification**<br>**(Bolded text is the model specification.** *Scripted text is optional and if used, should match the format & style used in the final specification.*) | **Instructions/Rationale** |
|---|---|
| **3. TSC System Requirements** | |
| **3.1 Surface Preparation Requirement** | |
| **3.1.1 Surface Finish. The steel substrate shall be abrasive blasted to _____(a)_____. Degrease per SSPC-SP-1 if oil/grease contaminated.** | (a) Specify either white metal finish, SSPC-SP 5/NACE No. 1, for marine and immersion service; or near-white metal finish, SSPC-SP 10/NACE No. 2, for other service applications. |
| **3.1.2 Blasting Media Requirement. Use _____(a)_____angular blasting media to produce the angular profile depth specified by Section 3.1.3 below. Mineral and slag abrasives shall be selected and evaluated per SSPC-AB 1.** | (a) Specify abrasive basting media type and size. See Note (1). |
| **3.1.3 Blast Angular Profile Depth. The steel substrate shall have an angular profile depth ≥ 2.5 mil [63 μm] with a sharp angular shape.** | |
| **3.1.4 Blast Profile Measurement Schedule. Measure the angular profile depth in a measurement spot approximately every _____(a)_____of blasted surface. Take 3 measurements per spot in approximately a 1.5-in.$^2$ [10-cm$^2$] area. Average the measurements and record in the Job Control Record (JCR). (See Note 2 of Annex A)** | (a) Specify the minimum area, e.g., 100 to 200 ft$^2$ [10-20 m$^2$]. |
| **3.2 Thermal spray Coating (TSC) Requirement** | |
| **3.2.1 Thermal Spray Feedstock Requirement**<br>**Use __(a)__thermal spray wire.** | (a) Specify wire per Annex C or ASTM B 833. |
| **3.2.2 TSC Thickness Requirement**<br>**The minimum TSC thickness shall be _____(a)_____.**<br>**The maximum TSC thickness shall be _____(b)_____.**<br>**Measure TSC thickness per SSPC-PA 2.** | (a) Specify the minimum thickness.<br>(b) Specify the maximum thickness. |
| **3.2.3 TSC Tensile Bond Requirement**<br>**(a) The TSC shall have a minimum tensile bond of _____(a)_____ psi _____[MPa] per ASTM D 4541 using a self-aligning portable test instrument for the coating thickness specified in 3.2.2.**<br>**Use the following adhesive: _____(b)_____ manufactured by _____(c)_____.**<br>**Record this information in the Job Control Record (JCR, see Note (2)) and the expiration date for the use of the adhesive.**<br>**For the adhesive used, attach the manufacturer's instructions to the Job Reference Standard (JRS, see Note (3)).** | (a) Specify the minimum tensile bond.<br>(b) Adhesive type.<br>(c) Manufacturer of the adhesive. |

| The Model Specification<br><br>**(Bolded text is the model specification.** *Scripted text is optional and if used, should match the format & style used in the final specification.)* | Instructions/Rationale |
|---|---|
| **3.2.4 Bend Test**<br><br>**Conduct a bend test at the beginning of each work shift or crew change:**<br><br>**(1) Use carbon steel coupons of approximate dimensions 2 x 4 to 8 x 0.050 in. [50 x 100 to 200 x 1.25 mm].**<br><br>**(a) Surface preparation per contract specification.**<br><br>**(b) Spray 8-10 mils [200-250 μm] thick TSC. The TSC should be sprayed in crossing passes laying down approximately 3-4 mils [75-100 μm] per pass.**<br><br>**(2) Bend coupons 180 degrees around a 0.5-in. [13-mm] diameter mandrel.**<br><br>**Bend test passes if there is no cracking or only minor cracks with no spalling or lifting (by a knife blade), from the substrate.**<br><br>**Bend test fails if the coating cracks with lifting (by a knife blade) from the substrate.** | The bend test (180-degree bend on a mandrel) is used as a qualitative test for proper surface preparation, equipment setup, and spray parameters. The bend test puts the thermal spray coating in tension. The mandrel diameter for the threshold of cracking depends on substrate thickness, coating thickness, and mandrel diameter. |
| *3.2.5 TSC Porosity Requirement*<br><br>*The TSC shall have a porosity ≤ ____(a)____ % per metallographic analysis of a bend coupon made during the Contract Pre-Award Validation. See Note 5.* | *(a) Flame and arc spraying aluminum and zinc for the corrosion protection of steel generally have porosity ≤ 15%. The TSC thickness should be selected so that there is no inter-connected porosity to the substrate. A lower porosity TSC requires less thickness. Porosity measurements are not used for in-process quality control in metallizing for corrosion protection of steel. However, a metallograph sample must be used to evaluate the TSC porosity and confirm the TSC non-through porosity thickness for the contract-specified thickness. If required, the porosity metallograph sample should be taken from the bend coupon made during the purchaser's witnessing of the preparation of the Job Reference Standard.* |
| *3.3 Sealers and Topcoats*<br><br>*All paint coatings shall be applied according to SSPC-PA 1, "Shop, Field and Maintenance Painting", and the paint manufacturer's instructions for use of the product with a thermal sprayed coating system.*<br><br>*Use a heat-resistant silicone alkyd aluminum paint or equivalent sealer on components whose operating temperatures are greater than 80°C [175°F].* | *Specify use of sealer when (a) the service environment precludes effectiveness of the natural oxidation to "fill and seal" the pores or (b) a paint topcoat (cosmetic and/or functional purpose) is specified. Long delay times will preclude adequate penetration of the sealer into the pores of the TSC. The sealer must be chemically compatible with the TSC material and the topcoat.* |

| **The Model Specification**<br>**(Bolded text is the model specification.** *Scripted text is optional and if used, should match the format & style used in the final specification.***)** | **Instructions/Rationale** |
|---|---|
| *3.3.1 Sealer*<br>*(1) Use the sealer _____(a)_____ manufactured by:_____(b)_____.*<br>*(2) Follow paint manufacturer's application instructions for applying the sealer on TSCs. The seal coat shall be thin enough when applied to penetrate into the body of the TSC and seal the porosity. Added thickness to porous TSC should not be measurable. Typically the seal coat is applied at a spreading rate resulting in a theoretical 1.5 mils [38 microns] dry film thickness.*<br>*(3) Sealer Application*<br>*For shop work, apply sealers immediately after thermal spraying.*<br>*For fieldwork, apply the sealer as soon after thermal spraying as possible but preferably within 8 hours.*<br>*If sealer cannot be applied within 8 hours, verify that the TSC (a) has not been contaminated by visual (10x) inspection and (b) is dust free using the clear cellophane tape test (ISO 8502-3).* | *(a) Specify formula or other unique identification.*<br>*(b) Specify manufacturer.* |
| *3.3.2 Topcoat.*<br>*(1) Use the topcoat _____(a)_____ manufactured by:_____(b)_____.*<br>*(2) Apply the topcoat to a dry film thickness (DFT) of ___(c)___ per manufacturer's instructions.* | *(a) Specify formula or other unique identification.*<br>*(b) Specify manufacturer.*<br>*(c) Specify thickness from similar successful applications or manufacturer's recommendations for topcoating sealers on TSC's.* |
| **4. Surface Preparation**<br>**Use blasting equipment, materials, and procedures that will produce the Section 3.1 metal finish and an angular profile ≥ 2.5 mil [63 µm].**<br>**The suitability of the blasting, media, procedures, and equipment shall be validated in the Contract Pre-Award Validation. See Note 5.** | Blasting media is specified in 3.1.2. |
| **5. TSC Application** | |
| **5.1 Thermal Spray Equipment Setup**<br>**5.1.1 Thermal spray equipment shall be set up, calibrated, and operated per the manufacturer's instructions and technical manuals or the TSCA's refinement thereof and as validated by the Job Reference Standard (JRS). See Note 3.**<br>**5.1.2 Spray parameters shall be set for spraying the specified thermal spray material and, at a minimum, be validated with the bend test. A bend test will be satisfactorily performed at the beginning of crew and shift changes.**<br>**5.1.3 A copy of the spray parameters used shall be attached to the JCR.**<br>**5.2 Post-Blasting Substrate Condition and Thermal Spraying Period**<br>**5.2.1 Steel Surface Temperature**<br>**The steel surface temperature shall be at least 5°F [3°C] above the dew point.** | |

| The Model Specification<br>(**Bolded text is the model specification.** *Scripted text is optional and if used, should match the format & style used in the final specification.*) | Instructions/Rationale |
|---|---|
| **5.2.2 Holding Period**<br>**(1) Time between the completion of the final anchor-tooth blasting (or final brush blasting) and the completion of the thermal spraying should be no greater than 6 hours for steel substrates. In high humidity and damp environments, shorter holding periods shall be used. If rust bloom or a degraded coating appears at any time while spraying, 5.5.4 applies.**<br>**(2) In low-humidity environments or in enclosed spaces using industrial dehumidification equipment, it will be possible to retard the oxidation of the steel and hold the surface finish for more than 6 hours. The TSCA, with the concurrence of the purchaser, can validate a holding period greater than 6 hours by determining the acceptable temperature-humidity envelope for the work enclosure by spraying and analyzing bend coupons, tensile bond coupons, or both.**<br>**(3) For small and movable parts, if more than 15 minutes is expected to elapse between completion of surface preparation and the start of thermal spraying, or if the part is moved to another location, the prepared surface should be protected from moisture, contamination, and finger/hand marks. Wrapping with clean print-free paper is normally adequate.** | |
| *5.3 TSC Flash/Primer Coat*<br>*5.3.1 A 1-2 mil [25-50 µm] flash/primer coat of the TSC may be applied within 6 hours of completing surface preparation to extend the holding period for up to 4 further hours beyond the complete application of the flash coat. The final TSC thickness, however, shall be applied within 4 hours of the completion of the application of the flash coat provided the TSC can be maintained free of contamination.* | *Specify the use of a Flash/Primer TSC when there is a requirement to extend the time-based holding period beyond that specified in 5.2.2.* |
| *5.3.1 Validate the use of the Flash TSC holding period with a ____(a)____.*<br>*Clean and abrasive blast a representative job area and 3 bend-test coupons.*<br>*Apply a flash TSC to the representative job area and the 3 bend coupons.*<br>*Wait the delay period in representative environmental conditions and apply the final TSC thickness.*<br>*Flash TSC and holding period are acceptable if the tensile bond specified in Section 3.2.3 or bend test, or both, are satisfactory.* | *(a) Specify validation method, i.e., with a tensile bond measurement or bend test, or both.* |
| **5.4 Preheating**<br>**For flame spraying, preheat the initial starting area to approximately 50°C [120°F] to prevent condensation of moisture in the flame onto the substrate. Validate preheating and non-preheating requirements with a ____(a)____.** | Specify the preheating requirement for flame spraying. Preheating is not normally required for arc spraying.<br>(a) Specify validation method, i.e., with a tensile bond measurement or bend test, or both. |

| **The Model Specification**<br>**(Bolded text is the model specification.** *Scripted text is optional and if used, should match the format & style used in the final specification.***)** | **Instructions/Rationale** |
|---|---|
| **5.5 Thermal Spraying**<br>**5.5.1 Apply the specified coating thickness (Section 3.2.2) in overlapping passes. The coating tensile bond strength is greater when the spray passes are kept thin. Laying down an excessively thick spray pass increases the internal stresses in the TSC and will decrease the ultimate tensile-bond strength of the total thermal spray coating. Confirm the suitability of the crossing-pass thickness with _____(a)_____ measurement.** | (a) Specify validation method, i.e., with a tensile bond measurement or bend test, or both. |
| **5.5.2 For manual spraying:**<br>**(1) On non-fixtured components, spray perpendicular crossing passes to minimize thin (below contract-specified thickness) areas.**<br>**(2) On fixtured rotating components, spray perpendicular overlapping passes so as to obtain the contract-specified thickness as the spray gun is advanced over the rotating component.**<br>**5.5.3 For mechanized spraying, program overlapping or crossing passes, or both, to eliminate thin spots and stay within the coating thickness specification.**<br>**5.5.4 If rust bloom, blistering, or a degraded coating appears at any time during the application of the TSC, the following procedure applies:**<br>**(1) Stop spraying.**<br>**(2) Mark off the acceptable sprayed area.**<br>**(3) Call the TSC inspector to observe, evaluate, and record the error. The inspector shall immediately notify the purchaser of the deficiency and request instructions.** | |
| *5.6 Thermal spraying in low temperature environments (below freezing)*<br>*No moisture or condensation on the surface is permissible during surface preparation and thermal spraying.*<br>*Qualify TSC period with a _____(a)_____.*<br>*Meet the tensile bond and metallographic requirements of the purchasing contract.* | *Include 5.6 for thermal spraying in low temperature environments (below freezing).*<br>*(a) Specify validation method, i.e., with a tensile bond measurement or bend test, or both.* |
| **5.7 TSC Measurement Schedule**<br>**(1) The TSC shall be made in accordance with SSPC-PA 2.**<br>**(2) Use a measurement line for flat surfaces. Take the average value of 5 readings taken in line at 1 in. [2.5 cm] intervals. The line measurement will measure the peaks and valleys of the TSC.**<br>**(3) Use a measurement spot for complex geometry's and geometry transitions. The measurement spot should be approximately 1.5 in.$^2$ [10 cm$^2$]. The spot measurement may not measure the peaks and valleys of the TSC. Note 4 illustrates the line and spot measurements.**<br>**(4) Record in the JCR.** | |

| **The Model Specification**<br>**(Bolded text is the model specification.** *Scripted text is optional and if used, should match the format & style used in the final specification.***)** | **Instructions/Rationale** |
|---|---|
| *6. Sealer and Topcoat*<br>*The seal and topcoat shall be applied according to SSPC-PA 1, "Shop, Field and Maintenance Painting", and the paint manufacturer's recommendations for use of the product with a TSC system.* | *Include this section if a sealer is specified.* |
| *6.1 Apply sealer as specified in Section 3.3.1.* | *Include this section if a sealer is specified.* |
| *6.2 Apply topcoats as specified in Section 3.3.2.* | *Include this section if a topcoat is specified.* |
| **7. TSCA's Detailed Procedure**<br>**The TSCA shall submit the detailed procedures conforming to Section 4 (surface preparation), Section 5 (thermal spraying) and Section 6 (Sealer, and topcoat). The procedures shall detail the equipment, application process, in-process quality control, and Job Control Record to be used for the contract work. The information shall include:**<br>**(1) Detailed procedures for surface preparation, thermal spraying, sealing/topcoating, and the in-process quality control checkpoints.**<br>**(2) Equipment (surface preparation, thermal spraying, sealing & topcoating, and the in-process quality control) to be used and for which the detailed procedures apply.**<br>**(3) Blasting media, thermal spray feedstock, and sealing/topcoating materials.**<br>**(4) Job Reference Standard (JRS). See Note 3.**<br>**(5) Job Control Record (JCR). See Note 2 and Annex B.**<br>**(6) Repair procedure for defective TSCs.** | Specify the requirements for the following information as required: Safety, Thermal spray Operator Qualification, TSCA work performance history, and customer contact references for validation. |
| **8. Contract Pre-Award Evaluation, Demonstration and Validation**<br>**8.1 Data Requirements**<br>**The TSCA shall submit the detailed information cited in Section 7. This information shall be submitted prior to contract approval and at least _____(a)_____ days prior to Contract Pre-Award Evaluation Demonstration and Validation. See Note (5).** | (a) Specify lead time. |
| **8.2 Equipment & Process Demonstration & Validation**<br>**The actual equipment and processes to be used for the contract work shall be demonstrated and validated to produce the specified TSC. This demonstration and validation shall be scheduled _____(a)_____ days after delivery of the data requirements, Section 8.1.** | (a) Specify lead time. |

## Notes for the Model Specification:

(1) Blasting Media. — Use blasting equipment, media, and mesh size appropriate to meet the surface finish and the anchor-tooth profile requirements of the purchaser or purchasing contract. Mineral and slag abrasives should conform to SSPC-AB 1:

Type I - Natural Mineral Abrasives, Grade 3 (2.0 to 3.5 mils) or Grade 4 (3.0 to 5.0 mils).

Type II - Slag Abrasives, Grade 3 (2.0 to 3.5 mils) or Grade 4 (3.0 to 5.0 mils). The suitability of the blasting media and surface preparation process shall be validated during the preparation of the JRS.

Blasting Media and Mesh Size Found Suitable for TSCs on Steel Substrates

| Thermal Spray Material | Process | Blasting Media[a] | Size[b] |
|---|---|---|---|
| Al, Zn, 85/15, 90/10 MMC | Flame Wire & Arc Wire | Aluminum oxide<br>Angular steel grit<br>Copper & nickel slag<br>Garnet | 10-30 Mesh<br>G-16 to G-24 G-16 to G-24<br><br>G-16 to 30/40 |
| Al, Zn | Flame Powder | Aluminum oxide<br>Angular steel grit | 10-30 Mesh<br>G-16 to G-24 |

a. All blasting media should be dry and free of all oil/grease, fines, and materials not allowable in the blasting media material specification.
b. Select mesh size appropriate to the anchor-tooth depth requirement and the blasting equipment used.

(2) Job Control Record (JCR) — The JCR is a permanent record of the job. The JCR contains the essential job information and the in-process QC checkpoints required by this standard. The JCR includes information on safety precautions, and the equipment, parameters, and procedures for surface preparation, thermal spray, and sealing.

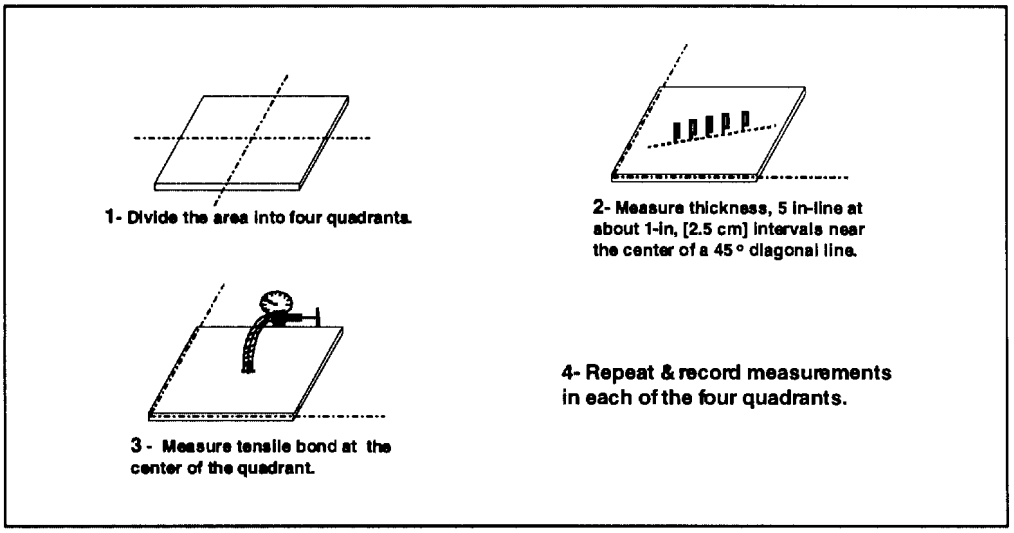
(3) Job Reference Standard (JRS) — The JRS is a job site pass/fail reference standard representative of the whole job or major sections of the job.

a. The JRS is made with the actual field equipment and the process parameters and procedures (surface preparation, thermal spraying, and sealing or sealing and topcoating with in-process quality control checkpoints) that will be used for the contracted work.

b. The JRS shall be made in representative environmental conditions during the contract work, with or without enclosure, as appropriate. The JRS shall be used as pass/fail reference for the applicator's in-process QC and the purchaser's inspector.

c. Make TSC thickness and tensile bond measurements per the Note (3) illustration.
- Four "5 in-line thickness measurements".
- Four portable tensile bond measurements.
- The JRS is unsatisfactory if any measurements are less than the contract minimum specified value.

Note (3) Illustration



(4) TSC Thickness Measurement

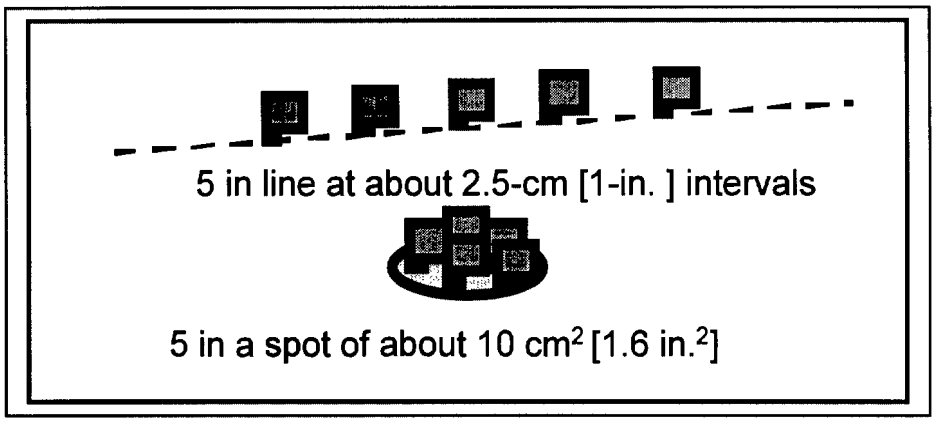
One measurement spot every 100 to 200 ft$^2$ [10-20 m$^2$] of applied TSC.

Take the average value of 5 readings per measurement line or spot.

Use a measurement line for flat surfaces. Take the average value of 5 readings taken in line at 1 in. [2.5 cm] intervals. The line measurement will measure the peaks and valleys of the TSC.

Use a measurement spot for complex geometries and geometry transitions. The measurement spot should be approximately 1.6 in.$^2$ [10 cm$^2$]. The spot measurement will not measure the peaks and valleys of the TSC.

Note (4) Illustration




(5) Contract Pre-Award Validation

If required by the purchaser, the evaluation of the suitability of the TSCA's equipment, application and QC processes, and technician/operator capabilities should be made prior to contract award. The contract pre-award validation should include:

(1) A written summary of the equipment capabilities, the process instruction, and operator experience proposed for the contract work.

(2) The written summary should include items cited in Sections (A), (B), and (C) below.

(A) Surface Preparation

(1) Equipment, material and MSDS, and process information on the abrasive blasting media, the surface preparation procedure, and the in-process QC method to be used.

(2) Demonstration of the surface preparation and QC actions with the equipment and personnel proposed for performing the entire project.

(3) JCR.

(4) Other information and demonstrations required by the purchasing contract.

(B) Thermal Spraying

(1) Equipment, feedstock and MSDS, procedure and parameters, and the QC method to be used.

(2) Demonstration of the procedure and QC actions with the equipment and personnel proposed for performing the entire project.

(3) JCR.

(4) Other information and demonstrations required by the purchasing contract.

**(C) Sealer and Topcoat**

**(1) Equipment, liquid coating products and their MSDS, manufacturer's application instructions for the application on the contract specified TSC feedstock, and the QC method to be used.**

**(2) Demonstration of the procedure and QC actions with the equipment and personnel proposed for performing the entire project.**

**(3) JCR.**

**(4) Other information and demonstrations required by the purchasing contract.**

# Annex B – Model Job Control Record

**Model Job Control Record (JCR)**

(Add steps specified in the contract if not specified in the model JCR. Delete steps not specified in the contract.)

**TSCA:** **JCR #:** **Date:**

**TSCA Point of Contact:** **Tel:**

**Customer/Contract #:**

**Customer POC:** **Tel:**

**Spray Equipment Data:** **Spray machine mfg:**_____ **Model:**_____

**Feedstock:**_____ **TSC minimum/maximum thickness, mils:**_____**min./**_____**max.**

**Thickness/pass:** _____**in. Standoff Distance:**_____**in. Other:**_____

**DAILY PRODUCTION RECORD** **Date:**_____

**Work Item/Area:**

| | Environmental Requirements | | Initials for Check-Off |
|---|---|---|---|
| | 1- The steel surface temperature shall be at least 3-deg C [5-deg F] above the dew point. | | |
| **Step** | **Production Process** | | |
| | **Requirement** | **In-Process QC Check Point** | |
| | **Surface Preparation - SSPC SP-5/NACE #2 with > 2.5-mil angular profile** )<br>(White metal finish required for marine, immersion, and other critical service.) | | |
| 1 | Degrease to remove oil, salts, & other contamination. | 1.1- Dust/dirt: Clear tape pulloff & visual/10x magnification. | |
| | | 1.2- Oil/grease: Solvent evaporation test. | |
| | | 1.3- Na & S salts: Potassium ferrocynide filter paper test. | |
| 2 | Validate clean blasting air & media. | 2.1- Clean blasting media per ASTM D 4950 (water sheen test). No fines. | |
| | | 2.2- Clean blasting air per ASTM D 4285 (air through clean cloth or air in bottle condensation test). | |
| 3 | Blast to specified finish with > 2.5-mil angular profile. | 3.1- Angular profile depth: Profile tape or depth-gage measurement per ASTM D 4542 & contract sampling schedule. | |
| 4 | Clean & dust-free surface. | 4.1- Clean & dust/dirt free surface per visual/10x magnification & the "clear-tape pull-off" test. | |
| | **Thermal Spraying** | | |
| 5 | **Holding Period** between completion of surface propitiation and completion of thermal spraying. | 5.1- Holding periods shall be no greater than 6 hours for steel substrates if there is no flash rusting prior to completion of thermal spraying. | |
| | | 5.3- In low-humidity environments or in enclosed spaces using industrial dehumidification equipment, validate a holding period > 6 hrs with bend coupons, portable tensile bond test, or both. | |
| | | 5.4- Protect small and movable parts, if more than 15 minutes is expected to elapse between surface preparation and the start of thermal spraying, or if the part is moved to another location. | |
| 6 | TSC Flash Primer | 6.1- A 25-50 µm [0.001-0.002 in.] flash/primer coat of the TSC may be applied within six hours of completing surface preparation to extend the holding period for up to four further hours beyond the complete application of the flash coat. | |
| | | 6.2- The final TSC thickness, however, shall be applied within four hours of the completion of the application of the flash coat provided the TSC can be maintained free of contamination. | |
| 7 | Preheating | 7.1 For flame spraying, preheat the initial starting area to approximately 120°C [250°F] to prevent water in the flame from condensing on the substrate. Validate preheating and non-preheating requirement with a bend test or tensile-bond measurement, or both. | |

# Annex B – Model Job Control Record

| Step | Production Process | | Initials for Check-Off |
|---|---|---|---|
| | Requirement | In-Process QC Check Point | |
| 8 | Thermal Spraying | 8.1- The specified coating thickness, _____ [insert value from the specification] in overlapping passes. Confirm the suitability of the inter-pass thickness with a bend test, tensile-bond measurement, or both. | |
| | | 8.2- If rust bloom, blistering, or a degraded coating appears at any time during the application of the TSC: a) Stop spraying. b) Mark off the acceptable sprayed area. c) Call the TSC inspector to observe and evaluate the error, report deficiency to the purchaser for remedial action, and record the deficiency and actions taken to resume the job. | |
| 9 | TSC Measurement Schedule | Measure per Contract and record in the JCR: | |
| | | 9.1- Measure the TSC in accordance with SSPC-PA 2. | |
| | | 9.2- Take the average value of 5 readings per measurement line or spot. | |
| | | *9.3- Use a measurement line for flat surfaces* . Take the average value of 5 readings taken in line at 2.5 cm [1 in.] intervals. The line measurement will measure the peaks and valleys of the TSC. | |
| | | 9.4- Use a *measurement spot for complex geometries and geometry transitions.* The measurement spot should be approximately 10 sq. cm [1.6 sq. in.]. The spot measurement may not measure the measure the peaks and valleys of the TSC. | |
| | **Sealing & Topcoating** | | |
| 10 | If liquid sealer is specified: | 10.1- Apply the liquid seal coats as soon as possible after the TSC has been applied and before visible (10x magnification) oxidation of the TSC occurs: < 8 hrs for zinc and zinc alloy TSCs and < 24 hours for aluminum and aluminum alloys. | |
| | | 10.2- Apply liquid seal coat per manufacturer's instructions or as purchasing contract and only to clean dry TSC surfaces. | |
| 11 | If Intermediate & Topcoating is specified: | 11.1- Intermediate and topcoats shall be applied per manufacturer's instructions or the purchasing contract. | |

Remarks:

Thermal Sprayer (or QC Inspector) print name:_____ Signiture:_____
Date:_____

# Annex C - Chemical Composition Requirements for Aluminum, Zinc, and Their Alloy Wires

Aluminum, zinc, 85/15 Zn/Al, 55Al/45Zn arc-spray pseudo alloy, and 90 aluminum/10 alumina (volume %) metal matrix composite (MMC) are currently used for corrosion protection of steel. Aluminum, zinc, 85/15 Zn/Al, and 90/10 MMC are available in wire form. Aluminum and zinc are also available in powder form. The classification, by chemistry, of the aforementioned wires is given in Table C-1.

Table C-1 - Chemical Composition Requirements for Aluminum, Zinc, and Their Alloy Wires[(a)]

| | | Composition, Wt % (a) | | | | | | | | | | Other Elements | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Classification | Common Name | Al | Cr | Cu | Fe | Mn | Pb | Si | Sn | Ti | Zn | Element | Amount |
| W-Al-1100 | 1100 Aluminum | 99.00 min | ... | 0.05-0.20 | 0.95 (Fe+Si) | 0.05 | ... | 0.95 (Fe+Si) | ... | -- | 0.1 | .(d), (h).. | (d), (h)... |
| W-Al-1350 | 1350 Aluminum | 99.50 min | 0.01 | 0.05 | 0.40 | 0.01 | ... | 0.10 | ... | 0.02 (V+Ti) | 0.05 | Ga | 0.03 |
| W-Al-4043 | 4043 Silicon Aluminum | rem | -- | 0.30 | 0.8 | 0.05 | ... | 4.5-6.0 | ... | 0.20 | 0.10 | Mg (d) | 0.05 |
| W-Al-4047 | 4047 Silicon Aluminum | rem | ... | 0.30 | 0.8 | 0.15 | ... | 11.0-13.0 | ... | ... | 0.20 | Mg (d) | |
| W-Al-5356 | 5356 Mg Aluminum | rem | 0.05-0.20 | 0.10 | 0.40 | 0.05-0.20 | ... | 0.25 | ... | 0.06-0.20 | 0.10 | Mg (d) | 4.5-5.5 |
| W-Al-$Al_2O_3$ | Al MMC (c) | 88 min | ... | ... | ... | ... | ... | ... | ... | ... | ... | $Al_2O_3$ (d) | 8-12 |
| W-Zn-1 | 99.99 Zinc | 0.002 | ... | 0.005 | 0.003 | ... | 0.003 | ... | 0.001 | ... | 99.99 min | Cd | 0.003 |
| W-Zn-2 | 99.9 Zinc | 0.01 | ... | 0.02 | 0.02 | ... | 0.03 | ... | ... | ... | 99.9 min | Cd | 0.02 |
| W-ZnAl-1 | 98/2 Zinc-Aluminum | 1.5-2.5 | ... | ... | ... | ... | ... | ... | ... | ... | rem | non Zn/Al | 0.1 |
| W-ZnAl-2 | 85/15 Zinc-Aluminum | 14.0-16.0 | | | | | | | | | Rem | Other | 0.05 |

Notes:
(a) Single values shown are maximum percentages unless a minimum is specified.
(c) Vol% Aluminum Assn. 1060 Alloy (99.6% pure Al) with addition of 8-12 vol% $Al_2O_3$ powder, 8-10 micron diameter.
(d) 0.0008 Be max.
(h) Others: 0.05 max each, 0.15 max total.

## Annex D - Procedure for Calibration of Portable Test Instruments

**General.** Procedure is based on spraying a steel plate that has holes drilled to accept the ASTM C 633 tensile-bond test specimens, inserting the C 633 tensile specimen flush with one surface, and surface preparation and thermal spraying per application standard or contract specifications.

**Procedure.** Using the calibration fixture similar to Figure D-1:

1. Degrease calibration fixture and the ASTM C 633 and the ASTM D 4541 portable tester tensile-bond test specimens.
2. Mount the ASTM C 633 tensile specimens flush with one face of the plate. Use a release agent on the cylindrical surface of the tensile specimen to ease removal after thermal spraying. Use brackets or masking tape to firmly hold the tensile test specimen in place during the blasting and spraying.
3. Prepare the surface (angular grit blast) and apply thermal spray coating per contract specifications. Prepare at the same time the Job Reference Standard is being prepared. Use the same personnel, equipment, materials, and procedures that will be used during the production work.
4. Remove C 633 specimens and measure per ASTM C 633 method. Designate the average value as **C**.
5. Use ASTM-D 4541 portable tensile testing instrument and measure the tensile bond on the three locations on the steel plate. Designate the average value as **D**.
6. The calibration ratio of the portable tensile instrument measurement to the laboratory tensile measurement is **C/D**.
7. The portable C 633 equivalent tensile measurement, $\mathbf{P_{C633}}$, is estimated by

$$\mathbf{P_{C633} = p\,(C/D)}$$

where **p** is the portable tensile measurement.

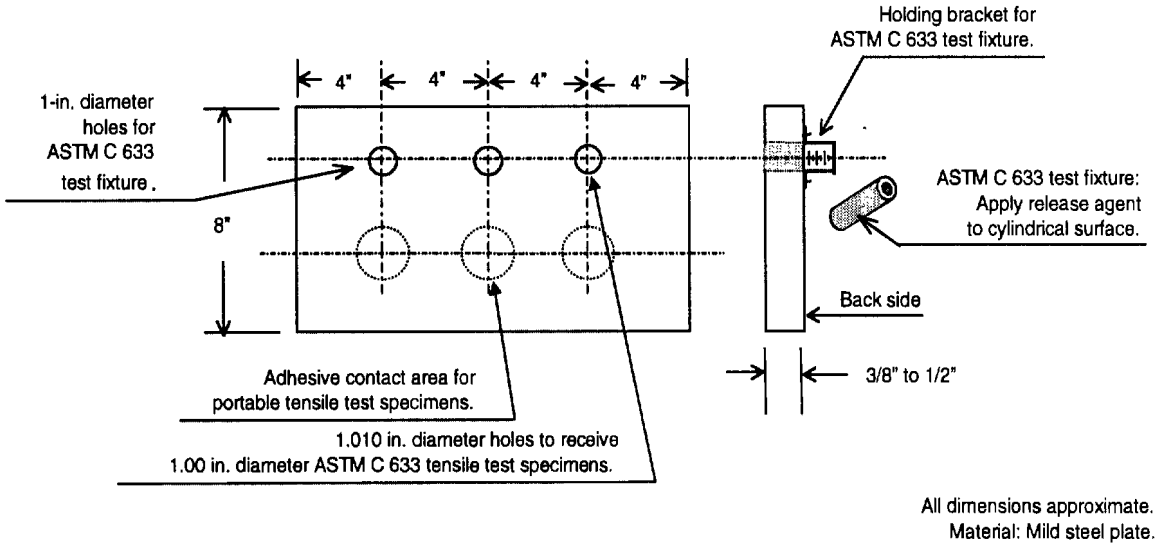



**Figure D-1 – Calibration Fixture**

# Annex E – Application Process Method

The major production and QC activities are shown in Figure E-1. The applicable Section and Quality Control Checkpoint (QCCP) numbers are noted in the lower right-hand corner of each process action.

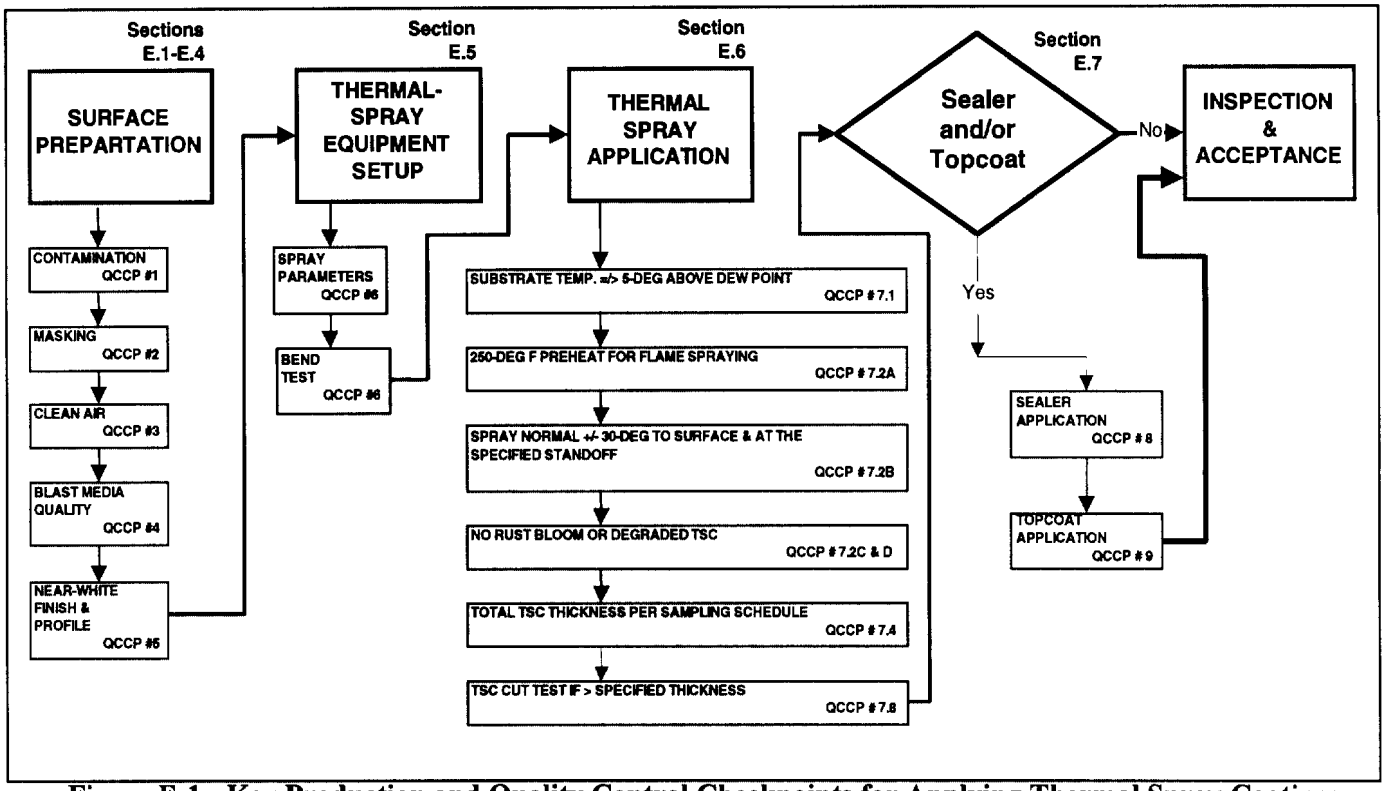



**Figure E-1 - Key Production and Quality Control Checkpoints for Applying Thermal Spray Coatings**

## E.1 Surface Preparation

Proper surface preparation is a critical and necessary step for successful thermal spray operations.

### E.1.1 Criteria

The steel substrate shall be prepared to at least a near-white metal finish per SSPC-SP 10/NACE No. 2. Marine service requires white metal finish per SSPC-SP 5/NACE No. 1.

Abrasive or centrifugal blast with a sharp angular abrasive to ≥ 2.5 mils [μm] anchor-tooth profile so as to provide a mechanical anchor for the TSC.

### E.1.2 Procedure

Surface preparation should be accomplished in one abrasive blasting/cleaning operation whenever possible. Steel substrates require approximately 80-100 psi [0.6-0.7 MPa] air-blasting pressure. Air pressures and media size should be reduced and adjusted to preclude damage/distortion to thin-gage materials. The blasting time on the workpiece should be adjusted to just clean the surface and cut the required anchor-tooth with minimum loss of metal. Blast angle should be as close to perpendicular as possible but in no case greater than ± 30° from the perpendicular to the work surface. Do not overblast; this will force the peaks back into the valleys. Use only angular and clean blasting media of suitable mesh size to

cut the ≥ 2.5 mils [63 μm] anchor-tooth profile. There must be no debris, no excessive fines, and no contamination such as sodium chloride, sulfur salts, and hazardous materials in the blasting media.

Use angular blasting media (e.g., steel grit, mineral slag, garnet, and aluminum oxide) that will cut an anchor-tooth (not peen) and which leaves only a tightly adherent residue. Clean, dry blasting air and clean blasting media without excessive fines are required. Dedicated blasting equipment is highly recommended for final anchor-tooth blasting in continuous thermal spray production.

## E.2 New Steel Substrate

### E.2.1 Degreasing

The substrate shall be degreased per SSPC-SP 1. Use QC Checkpoint # 1 to validate absence of oil and grease contamination.

### E.2.2 Masking

The following shall be masked for protection:

- All fit and function surfaces.
- Overspray control areas.
- Areas not to be thermal sprayed.

The fit and function areas are areas that must be protected from the blast cleaning, thermal spraying, and sealing and topcoating operations.

Overspray-control areas are areas of complex geometry where you cannot eliminate overspray. Use QC Checkpoint # 2 to validate masking suitability.

| QC Checkpoint #1 - Oil & Grease |
|---|
| Inspect for the absence of oil and grease contamination by the following:<br>**1.1.** Visual inspection during removal of oil/grease contamination. Continue degreasing until all visual signs of contamination are removed.<br>**1.2.** Conduct either the UV light, qualitative solvent evaporation test, or the heat test.<br>(1) Use an UV lamp to confirm the absence of oil or grease contamination.<br>(2) The solvent evaporation test is made by applying several drops or a small splash of a residueless solvent such as trichloromethane on the areas suspected of oil and grease retention (e.g., pitting and crevice corrosion areas, depressed areas especially those collecting contamination, etc.). An evaporation ring will form if there is oil or grease contamination.<br>(3) The heat test is made by using a torch to heat the degreased metal to about 225°F [110°C]. Residual oil/grease contamination is drawn to the metal surface and is visually apparent.<br>**1.3.** Continue inspection and degreasing (or high-pressure water blasting or oven- or flame-charring for severe contamination) until the test is passed. |

| QC Checkpoint #2 - Masking |
|---|
| Visually inspect the following:<br>**2.1.** All fit and function surfaces and those other surfaces and areas specified by the purchaser not to be abrasive blasted or to be thermal sprayed.<br>**2.2.** Ensure that the covers and masking are attached securely and will survive the blasting and thermal spraying operations.<br>**2.3.** Mask on complex geometries (e.g., pipe flanges, intersections of structural beams, and valve manifolds) to eliminate or minimize overspray. *Overspray is that TSC applied outside the authorized parameters, primarily the gun-to-substrate standoff distance and spray angle (perpendicular ± 30°).*<br>**2.4.** Potential overspray surfaces should be protected with clean, metal masks or clean, removable masking materials to prevent overspray from depositing on surfaces not already sprayed to the specified parameters. |

### E.2.3 Blast Equipment

The TSCA shall use mechanical (centrifugal wheel) and pressure-pot blast cleaning equipment and procedures. Do not use suction blasting equipment. Use QC Checkpoint #3 to validate clean and dry air.

| QC Checkpoint #3 - Clean & Dry Air |
|---|
| The air used for final anchor-tooth blasting and brush blasting prior to thermal spraying shall be clean and dry without moisture and oil. The water and oil content of the compressed air shall be qualitatively measured by the ASTM D 4285 method: |
| **3.1.** Slightly open a valve downstream of the filter or dryer. Allow the air to vent with a slight audible flow into an open, dry container for one minute. Any wetting or staining indicates contamination. |
| **3.2.** If moisture or contamination is detected, correct deficiency before going further. |
| **3.3.** Repeat **3.1** above, but place a clean, white cloth over the valve outlet. Any wetting or staining indicates contamination. |

### E.2.4 Surface Finish and Profile

Blast clean to at least a near-white-metal finish per SSPC-SP 10/NACE No. 2 with a ≥ 2.5 mils [63 μm] angular profile. Note: Substrate should be thick enough to preclude damage to the work piece or deformation from the abrasive blasting. Use QC Checkpoint #4 to validate clean blasting media; QC Checkpoint #5, to validate metal finish and profile depth.

| QC Checkpoint #4 - Clean Blasting Media |
|---|
| Prior to the use of the abrasive-blasting media for final anchor-tooth blasting or brush blasting: |
| **4.1.** Visually inspect the blasting media for the absence of contamination and debris using 10x magnification. |
| **4.2.** Inspect for the absence of oil contamination using the following procedure: |
| (1) Fill a small, clean bottle (4-6 oz [100-200 ml]) half-full of abrasive particles. |
| (2) Fill the remainder of the bottle with distilled water. |
| (3) Cap and shake the bottle. |
| (4) Inspect water for oil sheen. If any oil sheen is observed, do not use the blasting media for final anchor-tooth blasting. |
| (5) Clean the blasting equipment, especially the pot and hoses, then replace the blasting media and retest. |

| QC Checkpoint #5 - Near-White Finish & Anchor-Tooth Profile |
|---|
| **5.1** Visually inspect for near-white-metal finish or white metal finish if specified in the contract. Use the clear cellophane tape to confirm absence of dust as required. |
| **5.2** Measure the anchor-tooth profile with profile tape or depth gage micrometer. Make at least one measurement every 100 to 200 $ft^2$ [10 to 20 $m^2$] or as otherwise specified by the purchaser. |
| **5.3** If the profile is < 2.5 mils [65 μm] continue blasting to obtain ≥ 2.5 mils [65 μm] profile. |
| **5.4** Record information on sketches or drawings or as required by the purchasing contract. |

## E.3 Contaminated Steel Substrate

Contaminated steel is designated as such by the surface condition (degree of corrosion scale and pitting) and by the type and amount of contaminants imbedded in the surface. It requires more intensive surface preparation than new steel. To produce the minimum required near-white-metal finish with ≥ 2.5 mils [65 μm] profile, the surface preparation schedule should be tailored for the specific steel surfaces to be cleaned. High-pressure water cleaning, heat cleaning, chemical washing (followed by water flushing), steam cleaning, and abrasive blast cleaning, singly and in combination, may be required to clean contaminated steel.

### E.3.1 Degreasing

The surface shall be degreased as required (e.g., hydroblast, steam clean, solvent wash, or detergent wash).

### E.3.2 Masking and Blasting

Masking, blast equipment, blast media, and surface finish and profile are the same as for new steel as given in Section E.2. However, after blasting to the specified surface finish and angular-profile depth, wait 24 hours to observe for any rust bloom (i.e., the visual appearance of rust on the blast-cleaned surface).

#### E.3.2.1 Light Rust Bloom

If there is light rust bloom (light in color and greater than 10% of the surface area), the substrate area that will be thermal sprayed within the next six hours shall be re-blasted to achieve the specified level of cleanliness.

#### E.3.2.2 Heavy Rust Bloom

If there is heavy rust bloom (dark brown or black color), other cleaning methods shall be continued (e.g., wet-abrasive, high- and ultra-high-pressure water, or thermal charring singly or in combination) to remove the contamination.

#### E.3.2.3 Thermal Cleaning

SAFETY AND PROCEDURE PRECAUTION: Use this procedure only if there is no danger of an explosion or fire and no degradation of the metal temper. Do not exceed 575°F [300°C] on steel alloys.

Bake-out or burn-off the contamination (the dark brown or black surface areas) in an oven or with a rosebud torch. Keep the substrate temperature between 480-570°F [250-300°C] for the time necessary to bake-out or burn-off the oil and grease contamination.

Anchor-tooth blast the substrate area that will be thermal sprayed within the next six hours, or longer per E.4.2, to a minimum near-white metal finish. If an anchor-tooth profile has already been established, brush blast to a minimum near-white metal finish.

Repeat Steps 1) and 2) above as required until the thermal spray job is completed.

## E.4 Post-Blasting Substrate Condition and Thermal Spraying Period

### E.4.1 Steel Surface Temperature and Cleanliness

The steel surface temperature shall be at least 5°F [3°C] above the dew point. The surface cleanliness shall be SSPC-SP 10/NACE No. 2 finish as a minimum.

### E.4.2 Holding Period

TSC shall always be applied to white metal (SSPC-SP 5/NACE No. 1) or near-white metal finish (SSPC-SP 10/NACE No.2) surface, free of visible and invisible contaminants. It is common practice in fieldwork to apply the TSC during the same work shift as the final blast cleaning is performed. The logical end point of the holding period is when the surface cleanliness degrades or a change in performance (bend or tensile test) occurs.

As a general guide however, the time between the completion of the final anchor-tooth blasting (or final brush blasting) and the completion of the thermal spraying shall be no greater than about 6 hours for steel substrates. In high humidity and damp environments, shorter holding periods shall be used. If rust bloom or a degraded coating appears at any time while spraying, the procedure at the end of this section shall be strictly observed.

In low-humidity environments or in controlled environments with enclosed structures using industrial dehumidification equipment, it may be possible to retard the oxidation of the steel and hold the near-white-

metal finish for more than 6 hours. The TSCA, with the concurrence of the purchaser, can validate a holding period greater than 6 hours by determining the acceptable temperature-humidity envelope for the work enclosure by spraying and analyzing bend coupons or tensile bond coupons, or both.

When specified by the purchasing contract, a flash coat of TSC equal to or greater than 1 mil [25 μm] may be applied within 6 hours of completing surface preparation to extend the holding period for up to four hours beyond the complete application of the flash coat. The final TSC thickness, however, shall be applied within four hours of the completion of the application of the flash coat. This procedure shall be validated with a tensile bond measurement or bend test, or both, by spraying a flash coat and waiting the delay period before applying the final coating thickness.

For small and movable parts, if more than 15 minutes is expected to elapse between surface preparation and the start of thermal spraying, or if the part is moved to another location, the prepared surface should be protected from moisture, contamination, and finger/hand marks. Wrapping with clean print-free paper is normally adequate.

If rust bloom, blistering, or degraded coating appears at any time during the application of the TSC the following procedure applies:

(1) Stop spraying.

(2) Mark off the satisfactorily sprayed area.

(3) Repair the unsatisfactory TSC (i.e., remove degraded TSC and re-establish the minimum near-white-metal finish and anchor-tooth profile depth).

(4) Record the actions taken to resume the job in the JCR.

(5) Call the TSC inspector to observe and report the remedial action to the purchaser.

## E.5 Thermal Equipment Set-Up & Spraying Sequence

### E.5.1 Thermal Spray Equipment Set-Up

(1) Thermal spray equipment shall be set up, calibrated, and operated per the manufacturer's instructions and technical manuals or the TSCA's refinement thereto and as validated by the JRS.

(2) Spray parameters shall be set for spraying the specified thermal spray material and, at a minimum, be validated with the bend test of QC Checkpoint # 6.

(3) Attach a copy of the spray parameters to the JCR.

| **QC Checkpoint #6 - Macro-System Bend Test** (Required at beginning of each work shift or crew change) |
|---|
| **6.1.** Confirm that the equipment parameter settings are in accordance with those used for the validated JRS. |
| **6.2.** Observe the successful surface preparation, spraying the specified TSC thickness in crossing passes, and bend test at least one bend coupon at the beginning of each work shift. This is a macro or overall systems check. |
| **6.3.** If the bend test fails, identify and fix problems before continuing. |
| **6.4.** Record results, note identification, and retain the bend test coupons for the JCR. |

### E.5.2 Plan the Thermal Spraying Sequence

Thermal spraying should be started as soon as possible after the final anchor-tooth or brush blasting and completed within 6 hours for steel substrates subject to the temperature to dew point and holding period variations in Section E.4.

(1) The surface geometry of the item or area to be sprayed should be inspected. Spraying pass or sequence should be planned according to the following:

Maintain the gun as close to perpendicular as possible and within ± 30° from the perpendicular to the substrate.

Use the manufacturer's recommended standoff distance for the air cap installed or the TSCA's refinement thereto. See Table E1 for nominal standoff and spray pass width values.

**Table E1 - Flame- and Arc-Spray Standoff Distances and Spray Widths, Nominal**

| Thermal Spray Method | Perpendicular Standoff in. [mm] | Spray Pass Width, in. [mm] | |
|---|---|---|---|
| | | Air Cap | |
| | | Regular | Fan |
| Flame Wire | 5-7 [130-180] | 0.75 [20] | Not Available |
| Flame Powder | 8-10 [200-250] | 2 [50] | 3-4 [75-100] |
| Arc Wire | 6-8 [150-200] | 1.5 [40] | 3-6 [75-150] |

(3) For complex geometries where overspray cannot be eliminated, an overspray control area should be established. Clean, metal masks or clean, removable masking materials should be used to prevent overspray from depositing on surfaces not already sprayed to the specified thickness.

## E.6 TSC Application

(1) **Preheating** the starting area has been common practice in the past and should be continued until proven a benefit or inconsequential. Preheat the initial 1-2 $ft^2$ [0.1-0.2 $m^2$] starting-spray area to prevent water on the flame from condensing on the substrate.

(a) For flame spraying, preheat the initial starting area to approximately 250°F [120°C].

(b) Validate preheating requirements with the Job Reference Standard and the bend test or tensile test, or both.

(2) **Start-up and adjustment** of the spray gun shall be made off the workpiece (or surface to be thermal sprayed). In an enclosed space, spray onto a scrap metal sheet. Do not allow any non-validated spray coating on the prepared surface to be thermal sprayed.

(3) **The specified coating thickness** shall be applied in several perpendicular overlapping passes. The coating tensile bond strength is greater when the spray passes are kept thin. Laying down an excessively thick spray pass increases the internal stresses in the TSC and will decrease the ultimate tensile-bond strength of the TSC.

(a) For manual spraying, use crossing passes to minimize the thin spots in the coating.

(b) For mechanized spraying, use overlapping and crossing passes to eliminate thin spots and stay within the coating thickness specification. Validate the automated spraying parameters and spraying program with tensile-bond or metallographic analysis, or both.

(c) Use spray gun extensions to reach into recessed spaces and areas.

(4) **If rust bloom, blistering, or a degraded coating** appears at any time during the application of the TSC, the following procedure applies:

(a) Stop spraying.

(b) Mark off the acceptable sprayed area.

(c) Call the TSC inspector to observe and evaluate the error, notify the purchaser or his agent, and record the deficiency and the actions taken to resume the job in the JCR.

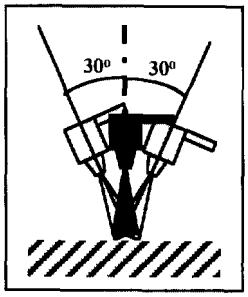
(5) **The TSC shall meet the system requirements and acceptance tests cited in Section 6.**

Use QC Checkpoint #7 to validate proper TSC application process.

## QC Checkpoint #7 - TSC Application

**7.1.** Measure/confirm substrate surface temperature with contract pyrometer to be ≥ 3°C [5°F] above the dew point:

a) Air temperature _____°F [_____°C].
b) Relative Humidity (RH) _____ %..
c) Dew Point _____°F [_____°C].
d) Substrate surface temperature _____ °F [ _____C°].
e) {Surface temperature (D)} ≥ {5°F above the dew point}: (Yes/No) _____.
f) If Yes ➔ Continue.
g) If No ➔ STOP. Wait for proper conditions and/or adjust the work-area space temperature and humidity conditions so that the steel temperature is ≥ 5°F above the dew point.



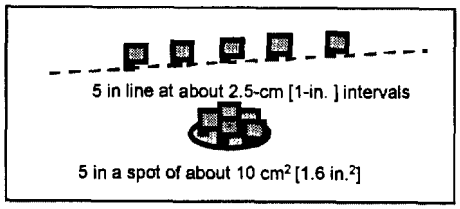

**7.2.** Observe the spraying process as specified in Section E.6:

a) Preheat to 250°F [120°C] when flame spraying.
b) Proper spray gun adjustment and spraying process (± 30° from the perpendicular, thickness/pass, and crossing passes).
c) No rust bloom on prepared steel during spraying.
d) No degraded TSC.

**7.3.** Specified TSC thickness. Ensure proper coating thickness in the contour transition areas (see **Step 7.5** below).

**7.4.** Measure the total TSC thickness:

a) One measurement spot every 100 to 200 ft² [10-20 m²] of applied TSC.
b) Take the average value of 5 readings per measurement line or spot.
   1) Use a measurement line for flat surfaces. Take the average value of 5 readings taken in line at 1 in. [2.5 cm] intervals. The line measurement will measure the peaks and valleys of the TSC.
   2) Use a measurement spot for complex geometries and geometry transitions. The measurement spot should be approximately 1.6 in.² [10 cm²]. The spot measurement will not measure the peaks and valleys of the TSC.




**7.5.** Measure TSC thickness in surface plane changes and attachments (brackets, angles, plates, studs, etc.) welded or permanently attached to the substrate.

**7.6.** If too thin, continue spraying to the specified thickness range.

**7.7.** If within the contract specified thickness range, go to **Step 7.9.**

**7.8.** If too thick, perform the TSC cut test.

a) **If PASS**, reapply the TSC over the TSC cut and go to **Step 7.9.**
b) **If FAIL**, remove defective coating and reapply the specified TSC. Record discrepancies and remedial action in the JCR.

**7.9.** Record the locations and values of the TSC thickness measurements in the JCR.

## E.7 Low Temperature Spraying

Thermal spraying in low temperature environments, less than 40° F [5°C] must:

(1) Meet the substrate surface temperature and holding period of Section E.4.1 and E.4.2. No moisture condensation on the surface is permissible during thermal spraying.

(2) Be qualified with a bend test or portable tensile bond test, or both.

Note: TSCs are mechanically bonded to the substrate. Substrate preheating may be required to improve the TSC tensile bond to the substrate and reduce internal stresses. Validate the preheating requirement, or non-requirement, during preparation of the JCR (see E.6 (1)).

## E.8 Sealer and Topcoat

Sealers and topcoats for TSCs shall be applied in accordance with SSPC-PA 1, the paint manufacturer's instruction for sealing and topcoating the contract specified TSC, and/or the purchasing contract.

If moisture is present or suspected in the TSC pores, the steel may be heated to 120°F [50°C] to remove the moisture prior to the seal coat application. When possible, the steel from the reverse side of the TSC shall be heated to minimize oxidation and contamination of the TSC prior to sealing.

### E.8.1 Sealer Application

The seal coat shall be thin enough when applied to penetrate into the body of the TSC and seal the porosity. Added thickness to porous TSC should not be measurable. Typically the seal coat is applied at a spreading rate resulting in a theoretical 1.5 mils [38 microns] dry film thickness.

For shop and field work, sealers should be applied as soon as possible after thermal spraying and preferably within eight hours.

If sealer cannot be applied within eight hours, verify that the TSC (a) has not been contaminated by visual inspection and (b) is dust free using the clear cellophane tape test (ISO 8502-3), before applying the sealer.

Use QC Checkpoint # 8 to validate proper application.

| QC Checkpoint #8 - Sealer Application |
|---|
| **8.1.** During application of the seal coat, visually validate complete coverage. The seal coat shall be thin enough when applied to penetrate into the body of the TSC and seal the porosity. Added thickness to the porous TSC should not be measurable. |

### E.8.2 Topcoat Application

Topcoats shall be applied per manufacturer's instructions or as specified in the purchasing contract. Do not apply a paint coating over an unsealed TSC.

Use QC Checkpoint # 9 to validate proper application.

| QC Checkpoint #9 – Topcoat Application & Thickness |
|---|
| **9.1** During application of the topcoat, visually validate complete coverage. |
| **9.2** If required by the contract, measure the thickness of the topcoat per SSPC-PA 2 using a Type 2 fixed-probe gage. The measurement may be made on (a) companion coupon or (b) the sealed TSC if the TSC thickness has been previously measured. |

## SSPC: The Society for Protective Coatings

# PAINTING SPECIFICATION NO. 24.00

## Latex Painting System for Industrial and Marine Atmospheres, Performance-Based

### 1. Scope

**1.1** This specification covers a painting system for steel surfaces based on multiple coats of air-drying, single-component latex paints having a total dry film thickness of a minimum of six mils (152 micrometers).

**1.2** A painting system is categorized according to its performance level over blast-cleaned steel, the intended substrate. (Note 11.1).

**1.3** The system is suitable for exposure in Environmental Zones IA (interior, normally dry), IB (exterior, normally dry), 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 3A (chemical exposure, acidic), 3B (chemical exposure, neutral), 3C (chemical exposure, alkaline) and 3D (chemical exposure, mild solvent).

**1.4**The system is not intended for immersion service.

### 2. Description

**2.1 SYSTEM COMPOSITION:** The painting system is comprised of paints based on pigmented emulsion (latex) binders.

**2.2 VOC CONTENT:**

**2.2.1** The painting system may or may not comply with all air pollution regulations. Consult applicable government regulations to determine maximum allowable VOC and proper VOC determination test method for a particular application. The manufacturer shall provide VOC information about the paints as supplied (in the container) and as applied in the field after recommended thinning. (See Notes 11.2 and 11.3).

**2.3 PERFORMANCE LEVELS**

**2.3.1** Painting systems shall be classified according performance achieved as follows:

Level 1: Accelerated Laboratory Testing
Level 2: Test Fence and Laboratory Evaluation
Level 3: Long-Term Exterior Exposure

**2.3.2** If no performance level is specified, Level 2 is assumed.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7, and form a part of this specification.

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

**3.3** if there is a conflict between the requirements of any of the cited reference standards and this specification, the requirements of this specification shall prevail.

**3.4 SSPC STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **SP 5/NACE No.** | White Metal Blast Cleaning |
| **VIS 2** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **B 117** | Method of Salt Spray (Fog) Testing |
| **D 523** | Test Method for Specular Gloss |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 610** | Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces |
| **D 714** | Test Method for Evaluating Degree of Blistering of Paints |
| **D 1200** | Test Method for Viscosity by Ford Viscosity Cup |
| **D 1211** | Test Method for Temperature-Change Resistance of Clear Nitrocellulose Lacquer Films Applied to Wood |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1654** | Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environment |
| **D 2369** | Test Methods for Volatile Content of Coatings |
| **D 3359** | Methods for Measuring Adhesion by Tape Test |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |
| **D 3960** | Practice for Determining Volatile Organic Content (VOC) of Paints and Related Coatings |
| **D 4417** | Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel |
| **D 4587** | Practice for Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV Condensation Light- and Water-Exposure Apparatus |
| **G 53** | (Canceled) Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) For Exposure of Non-Metallic Materials (See ASTM G 155.) |
| **G 92** | Standard Practice for Characteristics of Atmospheric Test Sites |
| **G 151** | Standard Practice for Exposing Non-Metallic Materials in Accelerated Test Devices that Use Laboratory Light Sources |

**3.6 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals—Precautionary Labeling |

**3.7 FEDERAL STANDARDS:**

**EPA Method 24** Determination of Volatile Matter Content, Water Content, Density, Volume Solids and Weight Solids of Surface Coatings (40 CFR Ch1, Part 60, Appendix A)

## 4. Composition

**4.1 VEHICLE:** The vehicle for the paints in this painting system is based on a stable polymer emulsion in an aqueous medium.

**4.2 PIGMENT:** The primer may contain environmentally compliant corrosion-inhibiting pigments. This does not preclude use of a non-inhibitive pigment-containing primer as long as the requirements of this specification are met.

**4.3 GENERAL:** The manufacturer is given latitude in the selection of other compositional ingredients provided that the paint and the painting system meet the requirements of this specification.

## 5. Performance Requirements

**5.1 ACCELERATED LABORATORY TESTING (LEVEL 1):** For Level 1 the painting system shall meet the requirements of Sections 6.2 through 6.4.

**5.2 TEST FENCE AND LABORATORY EVALUATION (LEVEL 2):** For Level 2 the painting system shall meet the requirements of Sections 6.2, 6.3, and 6.5.

**5.3 LONG-TERM EXTERIOR EXPOSURE (LEVEL 3):** For Level 3 the painting system shall meet the requirements of Sections 6.2, 6.3, and 6.6. (See Note 11.4.)

## 6. Testing Procedures

**6.1 STANDARD LABORATORY TESTING CONDITIONS:** For purposes of this specification, standard temperature shall be 73.5 ± 3.5°F (23 ± 2°C) and standard relative humidity shall be 50% ± 5%. The standard substrate shall be 4 inch x 12 inch x 1/8 inch (10 cm x 31 cm x 3.2 mm) thick ASTM A 569 hot-rolled steel abrasive blasted in accordance with SSPC-SP 5 to a profile of 1.7 ±0.5 mils (43 ± 13 micrometers). Measure blast profile in accordance with ASTM D 4417.

**6.2 ADHESION:** Apply the complete paint system to two panels according to the manufacturer's suggested finishing schedule. After drying for 14 days at standard conditions, adhesion of the system to the steel shall be determined using the ASTM D 3359 cross-hatch adhesion test. Each of the specimens shall have a minimum adhesion rating of 3A.

**6.3 EARLY RUST RESISTANCE OF SYSTEM:**

**6.3.1** Prepare and equilibrate a refrigerator at 50°F (10°C) and approximately 75 to 80% relative humidity. Condition the paints to be applied and the panels in the refrigerator for at least 45 minutes.

**6.3.2** Remove panels from refrigerator and apply one coat of primer, 1.4 to 1.8 mils (36 to 45 micrometers) dry above the profile, and return panels to the refrigerator. Dry for four hours or until film is dry to touch. (See Notes 11.5 and 11.6.) Again remove panels and apply one coat of topcoat (preferably white) at 1.4 to 1.8 dry mils (36 to 46 micrometers) and return panels to the refrigerator. Dry until film is dry to touch.

**6.3.3** Expose panels under continuous wet or condensing conditions at ambient temperature for approximately 16 hours (Note 11.7). At the end of 16 hours, immediately examine for rusting and blistering. The rusting shall not exceed 9 as judged by SSPC-VIS 2, and blistering shall not exceed 8F according to ASTM D 714.

**6.4 ACCELERATED LABORATORY TESTING:**

**6.4.1 Accelerated Weathering Test:** Apply the painting system to four panels, prepared as described in Section 6.1, according to the manufacturer's recommendations.

Provided by : www.spic.ir Licensee: NISOC Library

After drying for two weeks at standard conditions, expose panels in the apparatus described in ASTM G 53 (equipped with a UVA-340 Bulb) for 1,000 hours. (see Note 11.8.) The test cycle is four hours UV exposure (135°F, 57°C) followed by four hours of condensation (112°F, 44°C) (Note 11.9). There shall be no cracking, rusting, or blistering (Note 11.10).

**6.4 .2 Thermal Shock Test:** Allow panels tested in Section 6.4.1 to equilibrate at least 16 hours. Test panels in accordance with the procedure of ASTM D 1211 for ten cycles. One cycle in this test constitutes a period of high temperature followed by exposure to low temperature and then a return to room temperature. Panels should be patted dry with cheesecloth if wet, taking care not to disturb the coated surface. There shall be no checking or cracking (Note 11.11).

**6.4.3 Salt Fog Test:** Allow panels tested in Section 6.4.2 to equilibrate for at least 16 hours. Scribe a four-inch (100 mm) vertical line on the lower portion of the panel one inch (25 mm) from the bottom edge. The conditions of making the scribe shall be as described in ASTM D 1654. Expose panels in the salt fog cabinet according to ASTM B 117. Panels shall be examined for rusting and blistering at 96-hour intervals for a period of 500 hours. The rusting shall not exceed 8 according to SSPC-VIS 2 or ASTM D 610, and blistering shall not exceed 8F according to ASTM D 714. Undercutting at the scribe, according to ASTM D 1654, shall not exceed 1/8 inch (3.2 mm) from the center of the scribe.

**6.5 TEST FENCE AND LABORATORY EVALUATION:**

**6.5.1** Apply the painting system to four panels and allow to dry for two weeks, in accordance with Section 6.1.

**6.5.2** Expose panels for a minimum of 12 months on a test fence at an industrial or marine site having a minimum annual mean precipitation of 25 inches (635 mm) per year (Note 11.12). Other criteria for classifying the environment, such as corrosion rate of bare steel or bare zinc (in accordance with ASTM G 92), or mean annual temperature may also be required by the purchaser (Note 11.13).

**6.5.3** The rusting shall not exceed 9 as indicated by SSPC-VIS 2 or ASTM D 610, and there shall be no blistering as judged by ASTM D 714.

**6.5.4** The panels shall then be subjected to the Thermal Shock Test (and rated as described in Section 6.4.2) followed by the Salt Fog Test (and prepared and rated as described in Section 6.4.3).

**6.6 LONG-TERM EXTERIOR EXPOSURE:** Test panels coated as described in Section 6.4.1 shall be exposed for a minimum of 36 months as described in Section 6.5 and examined for rusting and blistering. The rusting shall not exceed 9 as judged by SSPC-VIS 2 or ASTM D 610. There shall be no blistering (Note 11.13).

## 7. Material Quality Assurance

**7.1** The supplier shall certify that the products furnished are essentially identical formulations to those used in qualification testing.

**7.2** The paint shall meet the requirements of Sections 7.3 through 7.8.

**7.3** Each component as received shall show no evidence of livering, skinning, or hard settling of the pigment. The inside of the container shall not be corroded. The material shall be easily dispersed in the liquid portion by hand stirring to form a smooth, homogeneous paint.

**7.4** The viscosity of the mixed primer shall be determined in accordance with ASTM D 562. Variance shall be within ±5 Krebs Units or equivalent units of another viscometer of the viscosity of the previously qualified primer.

**7.5** Density of the mixed paint shall be determined in accordance with ASTM D 1475. Variance shall be within ±0.4 pounds/gallon (50 g/l) of the density of the previously qualified paint.

**7.6** Solids percent by weight of the mixed paint shall be determined in accordance with ASTM D 2369. Variance shall be within ±2% of the percent solids by weight of the previously qualified paint.

**7.7** The paint manufacturer and the purchaser shall agree on an acceptable shelf life for the painting system.

**7.8** Other tests may be used to determine the acceptability of a lot or batch of a qualified product at the discretion of the purchaser.

## 8. Labeling

**8.1** Refer to ANSI Z129.1. Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**8.2 MARKING OF CONTAINER:** Each container shall be legibly marked with the following information:

Name: Latex Painting System (Primer or Topcoat)
Specification: SSPC Painting System PS 24.00
Color:
Lot Number:
Batch Number:
Stock Number:

Provided by : www.spic.ir Licensee: NISOC Library

Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be Required by Federal and State Laws:
Manufacturer's Name and Address:

**8.3 DIRECTIONS FOR USE:** The manufacturer shall supply complete instructions covering uses, surface preparation, mixing, thinning, volume solids, application methods, application conditions, pot life, wet and dry film thicknesses, temperature and humidity limitations, drying times, etc., with each container of paint.

## 9. Inspection

**9.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 11.14.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. In no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**9.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**9.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 10. Disclaimer

**10.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**10.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 11. Notes

Notes are not requirements of this specification.

**11.1** The system may also be applied over sound painted surfaces in multiple coats of lower dry film thickness (three mils [76 micrometers] minimum total thickness).

**11.2** VOC information may be provided on the container label or the technical data sheet.

**11.3** ASTM D 3960 and EPA Method 24 are the most commonly used methods to determine VOC content.

**11.4** This specification describes a painting system designed to achieve long-term protection of the substrate. A detailed documentation of successful case histories of actual field performance may be used as an alternative to the specified testing regimen if agreed upon by the contracting parties. The paint supplier should furnish evidence of satisfactory long-term performance of the system in conditions similar to those of the specifier's environment.

**11.5 EARLY RUST RESISTANCE:**

**11.5.1** In a cool, damp application environment, proper development of water-borne products is inhibited and early rusting can result. The paint supplier should be required to furnish documentation verifying the ability of the system to meet the early rust resistance requirements of this specification. Documentation should include laboratory test data simulating application under the conditions described in Section 6.3 and sufficient field test work to confirm the laboratory test data.

**11.5.2** The Early Rust Resistance Test has been designed to expose the system to an extremely harsh environment. In this test, paint is applied in thin coats to a cool, active metal surface which is subjected to conditions of dampness for an extended period. Although successful performance in the test virtually assures excellent early rust resistance of the system, failure is not necessarily indicative of early rusting failure in the field.

**11.6** If the relative humidity in the laboratory area is 70% or greater at ambient room temperature (70°F, 21°C) or higher, the film will not dry to touch. If this condition occurs, the panel should be placed in a controlled environment meeting the conditions of Section 6.1.

**11.7** A suggested procedure for this phase of the test is as follows. Use a pan of water in which the panels are

Provided by : www.spic.ir Licensee: NISOC Library

suspended just above the water surface, horizontally face up. Cover the panels with wet cheesecloth, the ends of which are immersed in the water, to provide constant wicking and assurance that the panel surfaces are kept continually wet. Enclose the entire apparatus with a foil lid to insure constant humidity. Other apparatuses which provide these severe drying conditions can also be used.

**11.8** Paints harden on aging via solvent loss, oxidation, or curing. Excessive hardening can lead to adhesion/cracking/flaking failures. This accelerated weathering step is an attempt to test laboratory films that are approaching ultimate hardness.

**11.9** An alternative testing cycle, with eight hours UV exposure (140°F, 60°C) followed by four hours condensation (114°F, 45°C), can be used if agreed upon by the supplier and the purchaser. See ASTM D 4587.

**11.10** The cosmetic characteristics of the final coat (gloss, color, gloss and tint retention, etc.) should be agreed upon by the contracting parties and evaluated in accordance with ASTM D 523.

**11.11** The testing procedure in ASTM D 1211 is similar to that of a non-ASTM test used by the automotive coating industry and others. Because the equipment and procedure of ASTM D 1211 are more widely known, it is specified for use here. One cycle of the test consists of a period of seven hours at 140°F (60°C) followed by 16 hours at 10°F (-12°C) followed by one hour at room temperature (70°F, 21°C).

**11.12** Choice of exposure direction (horizontal, face up— maximum UV light and weathering; horizontal, face down—maximum condensation; South vertical—typical weathering; or South 45°—accelerated natural weathering) and environment shall be made consistent with the weathering/environmental conditions expected at the location of use of the system. If no direction is specified by the purchaser, South 45° shall be used.

**11.13** The 250 meter lot (800-ft lot) at the LaQue Center, Wrightsville (Kure) Beach, NC and the Neville Island and coke works sites in Pittsburgh, PA have exhibited average bare steel corrosion rates of one to three mils (25 to 76 micrometers) per year based on 12 months of exposure. Test systems used to establish performance requirements were evaluated at these sites, and the sites have been found suitable for the exterior exposure conditions of this specification.

**11.14** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# COATING SYSTEM NO. 26.00

## Aluminum Pigmented Epoxy Coating System
## Materials Specification, Performance-Based
## Type I, for Use over Blast Cleaned Steel
## Type II, for Use over Hand Cleaned Steel

## 1. Scope

**1.1** This specification covers the requirements for an ambient temperature cure, two-component aluminum pigmented epoxy coating that is intended for use as a single or multi-coat system on steel.

**1.2** Coating systems meeting this specification are suitable for exposures in environmental zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water, excluding immersion), 2B (frequently wet by salt water, excluding immersion), and 3B (chemical exposure, neutral). (See Note 13.1.)

**1.3** The specified coating system is intended for application by brush, spray, or roller. (See Note 13.2). Type I is for use over steel surfaces blast cleaned to SSPC-SP 6 or better. (See Note 13.3.) Type II is for use over non-blast cleaned as well as blast cleaned steel surfaces, i.e., surfaces cleaned to SSPC-SP 2 or better. (See Note 13.4.) For either Type I or Type II, the surface should be prepared in accordance with the manufacturer's written recommendations.

## 2. Description

### 2.1 COMPONENTS

**2.1.1** This coating is typically based on a reactive oxirane (epoxy) functional resin with an amine or polyamide functional curing agent. (See Section 4.)

**2.1.2** The principal functional pigment is aluminum paste or flake powder. (See Section 4.)

## 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.8 and form a part of this specification. A standard marked with an asterisk (*) is referenced only in the Notes, which are not requirements of this specification.

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

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

### 3.4 SSPC STANDARDS AND JOINT STANDARDS:

| | |
|---|---|
| **Guide 13** | Guide for the Identification and Use of Industrial Coating Systems in Computerized Product Databases |
| **ME 1** | Uncontaminated Rusted Steel |
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Paint Thickness with Magnetic Gauges |
| **SP 1** | Solvent Cleaning |
| **SP 2** | Hand Tool Cleaning |
| * **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| * **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| * **SP 8** | Pickling |
| * **SP 10/NACE No. 2** | Near-White Blast Cleaning |
| * **SP 11** | Power Tool Cleaning to Bare Metal |
| * **SP 12/NACE No. 5** | Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating |
| * **SP 14/NACE No. 8** | Industrial Blast Cleaning |
| **VIS 2** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |

### 3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:

| | |
|---|---|
| **A 36** | Specification for Structural Steel |
| **A 607** | Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or |

Provided by : www.spic.ir Licensee: NISOC Library

Vanadium, or Both, Hot-Rolled and Cold-Rolled
B 117 Practice for Operating Salt Spray (Fog) Apparatus
D 522 Test Methods for Mandrel Bend Test of Attached Organic Coatings
* D 523 Test Method for Specular Gloss
D 562 Test Method for Consistency of Paints Using the Stormer Viscometer
D 609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products
D 660 Test Method for Evaluating Degree of Checking of Exterior Paints
D 661 Test Method for Evaluating Degree of Cracking of Exterior Paints
D 714 Test Method for Evaluating Degree of Blistering of Paints
D 962 Specification for Aluminum Powder and Paste Pigments for Paints
* D 1296 Test Method for Odor of Volatile Solvents and Diluents
* D 1475 Test Method for Density of Paint, Varnish, Lacquer, and Related Products
* D 1535 Practice for Specifying Color by the Munsell System
* D 1640 Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
D 1654 Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
* D 2369 Test Method for Volatile Content of Coatings
* D 2371 Test Method for Pigment Content of Solvent-Reducible Paints
* D 2621 Test Method for Infrared Identification of Vehicle Solids from Solvent-Reducible Paints
D 3359 Test Methods for Measuring Adhesion by Tape Test
D 3924 Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials
D 3925 Practice for Sampling Liquid Paints and Related Pigmented Coatings
D 4417 Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
D 4585 Practice for Testing the Water Resistance of Coatings Using Controlled Condensation
D 5894 Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)

**3.6 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

**Z129.1** Hazardous Industrial Chemicals-Precautionary Labeling

**3.7 NACE INTERNATIONAL (NACE) STANDARD:**

**RP0287** Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape

**3.8 FEDERAL SPECIFICATIONS AND STANDARDS:**

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

**Method 3011** Condition in Container
**Method 4321** Brushing Properties
**Method 4331** Spraying Properties
**Method 4541** Working Properties and Appearance of Dried Film

## 4. Composition Requirements

**4.1** The manufacturer is given wide latitude in the selection of materials and manufacturing processes.

**4.2 ALUMINUM REQUIREMENT:** The aluminum metal used shall be certified as meeting ASTM D 962 and shall constitute a minimum of 6.0% by weight of the dried film.

**4.3 RESIN REQUIREMENT:** The epoxy resin together with the curing agent, as described in Section 2.1.1, shall constitute at least 60% by weight of total solids. (See Note 13.5.)

**4.4 PIGMENT REQUIREMENT:** Lead or chromate based pigments are prohibited.

## 5. Standard Testing Conditions

**5.1 ATMOSPHERIC CONDITIONS:** When testing the paint and its application, the conditions under which it is applied and cured shall conform to ASTM D 3924.

**5.2 SUBSTRATE:** The hot rolled steel test panels shall conform to ASTM A 36. (See Note 13.6)

**5.3 TEST PANELS:** There are two kinds of standard test panels: blast cleaned panels (Section 5.3.1) and standard rusted panels (Section 5.3.2). Panel size shall be 100 mm x 150 mm x 3.2 mm (4 inch x 6 inch x 1/8 inch) or greater.

Provided by : www.spic.ir Licensee: NISOC Library

**5.3.1 Blast Cleaned Panels:** Blast cleaned panels are used for laboratory physical testing (Section 7) and for the accelerated laboratory weathering tests (Section 8) of Type I coatings for use over blast cleaned steel. Test panels shall be solvent cleaned in accordance with SSPC-SP 1 prior to blast cleaning. The test panels shall be blast cleaned in accordance with SSPC-SP 5/NACE No. 1 and have a profile of 50 ± 25 micrometers (2.0 ± 1 mil). Measure the blast profile in accordance with ASTM D 4417 or NACE RP0287.

**5.3.2 Standard Rusted Panels:** For the accelerated laboratory weathering tests (Section 8) of Type II coatings for use over hand tool cleaned steel, the unpainted test panels shall be prepared in accordance with SSPC-ME 1.

**5.4 APPLICATION:** Thoroughly mix together both components of the coating following the manufacturer's written instructions. Allow the mixture to stand for the manufacturer's specified induction time, if stated. Apply the coating by spray at the atmospheric conditions described in Section 5.1 in accordance with SSPC-PA 1.

**5.5 DRY FILM THICKNESS:** The dry film thickness (DFT) shall be within the manufacturer's written recommended range per coat and shall not exceed the stated minimum by more than 50 micrometers (2 mils). If there is no recommended film thickness, then the thickness shall be 125 ± 25 micrometers (5 ± 1 mils) per coat for a two-coat system and 250 ± 50 micrometers (10 ± 2 mils) for a one-coat system. For the two-coat system, the second coat shall be applied within 18 to 30 hours after application of the first coat, unless specified otherwise by the manufacturer. In either case the film thickness shall be measured in accordance with SSPC-PA 2.

**5.6 CURE:** All coated panels to be tested will be allowed to cure for a minimum of seven days under ambient laboratory conditions after application of the final coat before physical testing is to begin.

**5.7 SCRIBING:** Scribe two parallel lines on the face of the coated panels so as to expose the underlying metal before testing. The lines shall be at least 2.5 cm (1 inch) from the edge, the top, and the bottom of each panel and at least 5 cm (2 inches) from each other. Each scribe shall be at least 6 cm (2.4 inches) long. The scribes may run vertically or at an angle across the face of the panel. Follow the scribe-making procedure described in ASTM D 1654.

## 6. Requirements of Liquid Coating

**6.1 PACKAGE STABILITY:** Perform the following tests: Measure the viscosity of each component of the coating in accordance with ASTM D 562. Then place each component in an appropriate closed container (i.e., a lined metal or plastic can) in an oven at 52 ± 1°C (125 ± 2°F). After 30 days, remove the coating from the oven and measure the viscosity of each component of the coating in accordance with ASTM D 562. The change in viscosity shall not exceed 10 Krebs units (KU). After mixing the aforementioned aged components according to manufacturer's written instructions and brushing out, the film shall be free from grains, lumps, or streaks.

**6.2 MECHANICAL STABILITY:** Test individual packages of the two pack system separately. Fill a one liter (one quart) friction top can three-fourths full and secure tightly. In an environment at room temperature, rotate on a jar roller for one week at 120 to 170 rpm. At the end of one week, there shall be no separation, coagulation, excessive thickening, loss in mechanical stability, or changes in viscosity greater than 10 KU.

**6.3 POT LIFE:** Thoroughly mix components to yield one liter (one quart) of prepared coating. Allow the mixed coating to stand at atmospheric conditions described in Section 5.1 for the pot life time specified by the manufacturer. At the end of this time period, the coating shall show no evidence of gelation, and still meet the requirements of Sections 7.1 and 7.3.

## 7. Laboratory Physical Tests of Applied Films

**7.1 APPLICATION PROPERTIES:** Thoroughly mix together both components of the coating. Allow the mixture to stand for the manufacturer's specified induction time, if stated. The paint shall be easily applied by brush, roller, or spray when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging during application or while drying.

**7.2 RECOAT TESTS:** Coat a test panel in accordance with Sections 5.3.1, 5.4, 5.5, and 5.6. Apply one additional coat according to Sections 5.4 and 5.5. There shall be no picking up or rolling up of the previous coat during application. After 24 hours, the subsequent film shall be smooth and uniform. (See Note 13.7.)

**7.3 FILM INTEGRITY:** Apply one coat of coating by the drawdown method in accordance with Sections 5.1, 5.3, 5.5 and 5.6. Mix coating per Section 5.4. Evaluate for checking and cracking in accordance with ASTM D 660 and D 661, respectively. Any checking or cracking rating of "8" or less is cause for rejection.

**7.4 FLEXIBILITY:** Prepare three replicate panels according to Sections 5.1, 5.4, 5.5 and 5.6. The substrate shall be cold rolled strip 0.8 mm (1/32 inch) (22 gage) thick. Recommended panel size is 100 mm x 150 mm (4 inch x 6 inch). Surface preparation shall be SSPC-SP 1. Test three replicate panels in accordance with ASTM D 522. The

Provided by : www.spic.ir Licensee: NISOC Library

elongation of each replicate panel shall be a minimum of 7.0 percent using Test Method A; or, if Test Method B is used, each replicate panel must exhibit no cracking when bent over a 19 mm (3/4 inch) diameter mandrel.

## 8. Accelerated Laboratory Weathering Tests

**8.1 TEST PANEL PREPARATION:** Prepare replicate panels in accordance with Section 5. For Type I coatings for use over blast cleaned steel, follow Section 5.3.1; for Type II coatings for use over hand tool cleaned steel, follow Section 5.3.2. Coat and seal all edges and the back side of each panel with a coating that will provide the necessary protection to these surfaces. The edges may become adequately covered during application of the test coating.

**8.2 CONDENSING HUMIDITY CABINET TEST:** Three replicate panels shall be exposed for 2000 hours in a condensation cabinet in accordance with ASTM D 4585.

**8.2.1 Rust Evaluation:** After 2000 hours, each replicate panel shall have a minimum rust rating of 9 in accordance with SSPC-VIS 2.

**8.2.2 Blister Evaluation:** After 2000 hours, the blister rating of each replicate panel shall be no worse than No. 8 Few in accordance with ASTM D 714. (See Note 13.8.)

**8.2.3 Scribe Undercutting Evaluation:** After 2000 hours, on each replicate panel, the maximum rusting, blistering, or undercutting at the scribe as measured by ASTM D 1654 shall not exceed 3.2 mm (1/8 inch) from the center of the scribe at any point along the scribe.

**8.3 CYCLIC SALT FOG/UV EXPOSURE TEST:** Six replicate panels shall be exposed for 2688 hours (16 weeks) in accordance with ASTM D 5894.

**8.3.1 Rust Evaluation:** After 2688 hours (16 weeks), each replicate panel shall be rated in accordance with SSPC-VIS 2. The average of the six test panels rounded to the nearest whole number shall be 10.

**8.3.2 Blister Evaluation:** After 2688 hours, each replicate panel shall be rated in accordance with ASTM D 714. Four of the six replicate test panels must have a blister rating of 10 (no blisters) and the other two replicate panels must have a blister rating no worse than No. 8 Few. (See Note 13.8.)

**8.3.3 Scribe Undercutting Evaluation:** After 2688 hours, on each replicate panel, measure by ASTM D 1654 the maximum rusting, blistering, or undercutting from the center of the scribe at any point along the scribe. Since there are two scribes on each panel, each panel will furnish two scribe data points. Compute the mean (average), x', and the standard deviation, s, of these 12 data points. The scribe undercutting test parameter, U, is the mean plus two standard deviations (U = x' + 2s). The scribe undercutting test parameter, U, rounded to the nearest millimeter, shall be less than or equal to 20 mm.

**8.4 SALT FOG/HOT/COLD CYCLIC TEST**

**8.4.1 Panel Preparation:** Prepare six replicate panels according to Section 8.1 except the substrate shall be smooth cold rolled steel as described in ASTM D 609, Type 2 or Type 3, and only one scribe per panel is necessary.

**8.4.2 Exposure Cycle:** Expose six replicate panels for five complete cycles. One cycle starts with 72 hours in the salt fog (ASTM B 117). Then the panels are transferred, without washing, to a freezer at –18±1°C (0±2°F) for 24 hours. Next, the panels are place in a convection oven at 66±1°C (150±2°F) for 24 hours. Finally, the panels are kept at room temperature for 48 hours.

**8.4.3 Panel Evaluation:** At the end of each cycle, press adhesive tape across the scribe at right angles to the scribe and quickly remove the tape by pulling perpendicular to the panel face. The adhesive tape shall be as specified in ASTM D 3359. Any removal of coating more than 3.1 mm (1/8 inch) constitutes a failure for this test. Five of the six replicate panels must pass five cycles for the coating system to meet the requirements of this specification. (See Note 13.10.)

## 9. Material Quality Assurance

**9.1** If the user chooses, tests may be used to determine the acceptability of a lot or batch of a qualified coating. See Note 13.10.

## 10. Labeling

**10.1** Labeling shall conform to ANSI Z129.1.

**10.2** Technical data shall be provided for at least all data elements categorized as “essential” in SSPC-Guide 13.

## 11. Inspection

**11.1** All coatings supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 13.11.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Asso-

Provided by : www.spic.ir Licensee: NISOC Library

ciation shall be used.

**11.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**11.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 12. Disclaimer

**12.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**12.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 13. Notes

Notes are not requirements of this specification.

**13.1** SSPC Environmental Zones covered in this specification are as follows:

| | |
|---|---|
| Zone 1A: | Interior, normally dry (or temporary protection). Very mild (oil base coatings now last six years or more). |
| Zone 1B: | Exteriors, normally dry (includes most areas where oil base coatings now last six years or more). |
| Zone 2A* | Frequently wet by fresh water. Involves condensation, splash, or spray, (Oil base coatings now last five years or less.) |
| Zone 2B* | Frequently wet by salt water. Involves condensation, splash, or spray. (Oil base coatings now last three years or less.) |
| Zone 3B | Chemical exposure, neutral (pH 5.0 to 10.0) |

* Zones 2A and 2B have been modified to exclude immersion.

**13.2** Normally, spray application is preferred for this type of system. However, brush or roller application has been reported to provide better adhesion to non-blast cleaned surfaces.

**13.3** Methods of cleaning considered better than SSPC-SP 6 include SSPC-SP 5 and SSPC-SP 10. In some instances, SSPC-SP 12 and SSPC-SP 11 have been shown to perform comparably with SSPC-SP 6. Pickled surfaces (SSPC-SP 8) and surfaces cleaned by water jetting (SSPC-SP 12) may not have a sufficiently high profile or surface roughness to meet the coating manufacturer's requirement.

**13.4** A hand cleaned surface must be clean, dry, and in sound condition with all oil, grease, loose rust, visible contaminants, peeling paint, and other foreign material removed. Methods of cleaning considered better than SSPC-SP 2 include: SSPC-SP 3, SSPC-SP 5/NACE No. 1, SSPC-SP 6/NACE No. 3, SSPC-SP 7/NACE No. 4, SSPC-SP 8, SSPC-SP 10/NACE No. 2, SSPC-SP 11, SSPC-SP 12 and SSPC SP-14/NACE No. 8. Pickled surfaces (SSPC-SP 8) and surfaces cleaned by water jetting (SSPC-SP 12) may not have a sufficiently high profile or surface roughness to meet the coating manufacturer's requirement. SSPC-SP 12/NACE No. 4 will restore the original profile if one exists.

**13.5 VOC CONTENT:** Each coating, after recommended thinning, must conform to published government regulations regarding volatile organic compound (VOC) content. VOC information should be supplied on the label or the technical data sheet. Various governmental agencies may have different VOC limits or use different methods of testing. The owner may modify this specification as necessary to specify a particular VOC content limit consistent with local regulations. Coatings meeting the composition and performance requirements of this specification usually have a VOC level between 230 and 340 g/L (1.9 and 2.8 lb/gal)

**13.6 STEEL TEST PANELS:** ASTM A 36 steel is frequently used; however, the specifier should be aware that ASTM A 36 steel may vary in chemical composition and hardness, which can effect blast profile and corrosion resistance. ASTM A 607 Grade 50 is a more consistent steel substrate for test panels.

**13.7** Coatings containing leafing grades of aluminum pigment are not designed to be topcoated. Thus, the primer in a two coat system should be formulated with a nonleafing grade of aluminum pigment. If a coating containing leafing grades of aluminum is expected to be topcoated, tests should be run to evaluate the compatibility of the topcoat. Usually, after two or more years of atmospheric weathering, a coating formulated with a leafing grade of aluminum can be topcoated without difficulty.

**13.8** Smaller size blisters are not considered to be as detrimental as larger blisters. Hence, a rating of No. 8 Few

Provided by : www.spic.ir Licensee: NISOC Library

would be better than a rating of No. 6 Few.

**13.9** For use in warm weather environments, the contracting parties may agree to waive the requirements of Section 8.4.

**13.10 QUALITY ASSURANCE TESTS:** The quality assurance tests are used to determine whether the supplied products are of the same type and quality as those originally tested and certified for acceptance. The selected tests should accurately and rapidly measure the physical and chemical characteristics of the coating necessary to verify that the supplied material is substantially the same as the previously accepted material. All of the quality assurance tests must be performed on the originally submitted qualification sample. The results of these tests are used to establish pass/fail criteria for quality assurance testing of supplied products.

**13.10.1 Establishing Quality Assurance Acceptance Criteria:** Many ASTM test methods contain precision and bias statements. Specification developers should be cognizant of the fact that these statements exist. Quality assurance test criteria should not be more stringent than the interlaboratory precision of the test methods used. For example a common quality assurance test is weight per gallon as measured by ASTM D 1475. The interlaboratory reproducibility at the 95% confidence level tells us that any two measurements that differ by more than 1.8% should be considered suspect. This only represents the precision of the measurement technique and does not account for normal variances in the manufactured product. A reasonable estimate for this batch to batch variance might be 2%. The batch to batch variance and the potential variance attributable to the measurement technique are additive. A paint that was originally accepted with a weight per gallon of 10 pounds would therefore be acceptable within the range 9.62 to 10.38 pounds per gallon (10 + 3.8%).

Example: A common quality assurance test is density (weight per gallon) as measured by ASTM D 1475. The interlaboratory reproducibility at the 95% confidence level tells us that because of errors associated with the method, any two measurements of the same material can differ by as much as 1.8%, without the measurements being considered suspect. This only represents the precision of the measurement technique and does not account for normal variances in the manufactured product.

The acceptable range for paint density must be stated. For example, a composition specification may state this requirement as 10.0 ± 0.2 lb/gal, 10.0 lb/gal ± 2%, or as a range from 9.8 to 10.2 lb/gal. The manufacturer of proprietary products should provide this information. Using these values, if the manufacturer's lab measures the density to be 9.8 lb/gal, the product meets the specification and the paint is shipped to the job. Because of the lab to lab variation of 1.8%, the user's lab may measure the density of this sample to be as low as 9.8 less 1.8% of 9.8 (equals 9.6) lb/gal. Similarly for the high end, the manufacturer may measure density of 10.2 lb/gal while the user measures 10.2 plus 1.8% of 10.2 (equals 10.4) lb/gal. The pass/fail criteria for the user to accept a batch of paint should therefore be 9.6 to 10.4 lb/gal.

Where precision and bias data are not available for a given test method, determine the standard deviation of a minimum of five measurements taken on the originally tested and certified material. The pass/fail criterion is that the measurement of the test sample shall fall within two standard deviations of the target value. The contracting parties must agree on a target value.

**13.10.2 Recommended Quality Assurance Tests:** Recommended quality assurance tests include but are not limited to, infrared analysis (ASTM D 2621), viscosity (ASTM D 562), weight per gallon (ASTM D 1475), total solids (ASTM D 2369), dry time (ASTM D 1640), percent pigment (ASTM D 2371), gloss (ASTM D 523), color (ASTM D 1535), condition in container (Fed. Std. 141, Method 3011), and odor (ASTM D 1296).

**13.11** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# COATING SYSTEM NO. 27.00

## Alkyd Coating System Materials Specification, Performance-Based

### 1. Scope

**1.1** This specification covers the requirements for an air-drying solvent-based alkyd coating system consisting of two or more coats of alkyd intended for use over blast cleaned steel. (See Note 13.1.) The specification covers both the system and the individual coating requirements. The requirements are based primarily on the performance of the coating system.

**1.2** The coating system is suitable for exposure in Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water, excluding immersion), and 2B (frequently wet by salt water, excluding immersion). (See Note 13.2.) The coating system is classified according to the drying time (fast, medium, slow) of the slowest drying coating layer.

### 2. Description

**2.1** This multi-coat alkyd coating system specification does not cover coating systems comprised of water-reducible alkyds.

**2.2 DRYING TIME:** The coating system shall be classified as Type 1 (fast drying), Type 2 (medium drying), or Type 3 (slow drying). See Section 6.4 regarding test methods and criteria for drying time.

**2.3 FINISH COAT GLOSS:** The finish coat shall be designated as flat, semigloss, or gloss in accordance with Section 7.3.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7, and form a part of this specification. A standard marked with an asterisk (*) is referenced only in the Notes, which are not requirements of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **Guide 13** | Guide for the Identification and Use of Industrial Coating Systems in Computerized Product Databases |
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness with Magnetic Gages |
| **SP 1** | Solvent Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **VIS 2** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **A 36** | Specification for Carbon Structural Steel |
| **A 607** | Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled |
| **D 522** | Test Methods for Mandrel Bend Test of Attached Organic Coatings |
| **D 523** | Test Method for Specular Gloss |
| * **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 714** | Test Method for Evaluating Degree of Blistering of Paints |
| * **D 823** | Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels |
| * **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| * **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| * **D 1535** | Practice for Specifying Color by the Munsell System |
| **D 1640** | Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature |
| **D 1654** | Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments |
| * **D 2369** | Test Method for Volatile Content of Coatings |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| * **D 2371** | Test Method for Pigment Content of Solvent-Reducible Paints |
| * **D 2621** | Test Method for Infrared Identification of Vehicle Solids from Solvent-Reducible Paints |
| **D 3359** | Test Methods for Measuring Adhesion by Tape Test |
| **D 3363** | Test Method for Film Hardness by Pencil Test |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |
| **D 4417** | Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel |
| **D 4585** | Practice for Testing the Water Resistance of Coatings Using Controlled Condensation |
| **D 4940** | Test Method for Conductimetric Analysis of Water-Soluble Ionic Contamination of Blasting Abrasives |
| **D 5894** | Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet) |

**3.6 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals-Precautionary Labeling |

**3.7 FEDERAL SPECIFICATIONS AND STANDARDS:**

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 3011** | Condition in Container |
| **Method 3021** | Skinning (Partially Filled Container) |
| **Method 4321** | Brushing Properties |
| **Method 4331** | Spraying Properties |
| **Method 4541** | Working Properties and Appearance of Dried Film |

## 4. Composition Requirements of Coating

**4.1 RESIN REQUIREMENT:** The resin component (non-volatile vehicle) shall be a minimum of 50% by weight of alkyd. An alkyd resin is defined as a resin system primarily derived from the esterification reaction product of a polyhydric alcohol and a polybasic acid, fatty acid, or oil. The specification permits latitude to the coating supplier in the choice of alkyd resins. Modified alkyd resins, including cross reaction products with other common resin forming polymers, are allowed. These include, but are not restricted to, urethane modified alkyd resins and alkyd phenolic resins. (See Note 13.3.)

**4.2 PIGMENT REQUIREMENT:** Lead or chromate based pigments are prohibited. (See Note 13.4.)

## 5. Standard Testing Conditions

**5.1 ATMOSPHERIC CONDITIONS:** When testing the paint and its application, the temperature under which it is applied and cured shall be 23 ± 2°C (73.5 ± 3.5°F).

**5.2 SUBSTRATE:** The hot rolled steel test panels shall conform to ASTM A 670, Grade 50. (See Note 13.5.)

**5.3 TEST PANELS:** Steel test panels measuring 75 mm x 150 mm x 3.2 mm (3 inch x 6 inch x 1/8 inch) or greater shall be blast cleaned to SSPC-SP 5/NACE No. 1. Test panels shall be solvent cleaned in accordance with SSPC-SP 1 prior to blast cleaning. The type of blast media shall be clearly identified and have conductivity less than 100 µS per ASTM D 4940. The panels shall have a nominal anchor pattern of 50 ± 25 µm (2.0 ± 1.0 mils) per ASTM D 4417.

**5.4 APPLICATION:** Apply the paint at the atmospheric conditions described in Section 5.1 in accordance with SSPC-PA 1 by spray to the front of the test panels. (See Note 13.6.) The number of coats shall be selected to match the manufacturer's recommendations.

**5.5 DRY FILM THICKNESS:** The dry film thickness (DFT) shall be within the manufacturer's written recommended range per coat and shall not exceed the stated minimum by more than 25 micrometers (1 mil). If there is no recommended film thickness, then the thickness shall be 50 ± 13 micrometers (2.0 ± 0.5 mils) per coat. The film thickness shall be measured in accordance with SSPC-PA 2. (See Note 13.7.)

**5.6 CURE:** Prior to any exposure testing, all panels shall be cured for a minimum of 14 and a maximum of 30 days at 16 to 27°C (60 to 80°F) and 35 to 65% relative humidity after application of the final coat.

**5.7 SCRIBING:** Scribe two parallel lines on the face of the coated panels so as to expose the underlying metal before testing. The lines shall be at least 1.2 cm (0.5 inch) from the edge, the top, and the bottom of each panel and at least 5 cm (2 inches) from each other. Each scribe shall be at least 6 cm (2.4 inches) long. The scribes may run vertically or at an angle across the face of the panel. Follow the scribe-making procedure described in ASTM D 1654.

## 6. Requirements of Liquid Coating

**6.1 WORKING PROPERTIES:** The paint shall be eas-

Provided by : www.spic.ir Licensee: NISOC Library

ily applied by brush, roller, or spray when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging during application or while drying.

**6.2 CONDITION IN CONTAINER:** The paint shall show no thickening, curdling, gelling, or hard caking when tested as specified in FED-STD-141, Method 3011, after storage for six months from the date of delivery, in a full, tightly covered container, at a temperature of 10 to 43°C (50 to 110°F).

**6.3 SKINNING:** There shall be no skinning in a three-quarters filled closed container after 48 hours when tested in the standard manner specified in FED-STD-141, Method 3021.

**6.4 DRYING TIME**

**6.4.1** Drying time for each coating shall be the dry-hard time as measured in accordance with ASTM D 1640. The coating system shall be classified according to the maximum drying time of the slowest drying coating as follows:

**6.4.2** Type 1 — Fast Drying: Less than or equal to 8 hours

**6.4.3** Type 2 — Medium Drying: 9 to 16 hours

**6.4.4** Type 3 — Slow Drying: 17 to 36 hours

## 7. Laboratory Physical Tests of Applied Films

**7.1 FLEXIBILITY OF COATING SYSTEM:** Prepare three test panels in accordance with Sections 5.1, 5.4, 5.5, and 5.6. The substrate shall be cold rolled strip 0.8 mm (1/32 inch) (22 gage) thick. Surface preparation shall be SSPC-SP 1. Recommended panel size is 100 mm x 150 mm (4 inch x 6 inch). Test triplicate panels in accordance with ASTM D 522. The elongation of each panel shall be a minimum of 28 percent using Test Method A or, if Test Method B is used, each replicate panel must exhibit no cracking when bent over a 3.2 mm (1/8 inch) diameter mandrel.

**7.2 HARDNESS OF COATING SYSTEM:** Prepare three test panels in accordance with Sections 5.1, 5.4, and 5.5. The substrate shall be any suitable thin gage [minimum 1.6 mm (1/16 inch)] steel panels. Surface preparation shall be SSPC-SP 1. Each panel shall exhibit minimum pencil hardness of 3B in accordance with ASTM D 3363 after 30 days air-dry at ambient temperature following the application of the final coat.

**7.3 GLOSS:** The specular gloss of the finish coat shall be tested in accordance with ASTM D 523. A flat alkyd finish coat shall have a maximum 85 degree specular gloss of 10. A semigloss alkyd finish coat shall have a 60 degree specular gloss between 30 and 60. A gloss alkyd finish coat shall have a 60 degree specular gloss greater than 60. Gloss of the primer and the intermediate coats shall be such that adequate adhesion shall occur between coats.

**7.4 ADHESION:** Prepare one panel in accordance with Sections 5.1 through 5.6. Perform the adhesion tape test in accordance with ASTM D 3359 at three different locations on the panel. Each test shall have a rating of 5A or 5B. For films thicker than 125 μm (5 mils), use Test Method A of ASTM D 3359.

## 8. Accelerated Laboratory Weathering Tests

**8.1 CONDENSING HUMIDITY CABINET TEST:** Prepare triplicate panels in accordance with Sections 5.1 through 5.6. Expose the panels for 500 hours in a condensation cabinet in accordance with ASTM D 4585.

**8.1.1 Rust Evaluation:** After 500 hours, each of the replicates shall have a minimum rust rating of 9 per SSPC-VIS 2.

**8.1.2 Blister Evaluation:** After 500 hours, blister ratings for each of the three specimens shall be no worse than No. 8 Few per ASTM D 714. (See Note 13.8.)

**8.2 CYCLIC SALT FOG/UV EXPOSURE TEST:** Prepare triplicate panels in accordance with Section 5. Coat and seal all edges and the back side of each panel with a coating or masking that will provide the necessary protection to these surfaces. Expose the panels in accordance with ASTM D 5894 for 1008 hours (6 weeks).

**8.2.1 Rust Evaluation:** After 1008 hours, each test panel shall have a minimum rust rating of 9 per SSPC-VIS 2.

**8.2.2 Blister Evaluation:** After 1008 hours, each test panel shall have a blister rating of 10 (no blisters) per ASTM D 714.

**8.2.3 Scribe Undercutting Evaluation:** After 1008 hours, measure the maximum undercutting from the center of the scribe at any point along the scribe on both sides of each scribe. Each scribe will thus provide two data points: the maximum undercutting on the right side of the scribe and the maximum undercutting on the left side of the scribe. Three replicate panels, each with two scribes, will provide 12 data points. Compute the mean (average), x', and the standard deviation, s, of these 12 data points. The scribe undercutting test parameter, U, is the mean plus two standard deviations ($U = x' + 2s$). The scribe undercutting test parameter, U, rounded to the nearest millimeter, shall be less than or equal to 12 mm.

Provided by : www.spic.ir Licensee: NISOC Library

## 9. Material Quality Assurance

**9.1** If the user chooses, tests may be used to determine the acceptability of a lot or batch of a qualified coating. (See Note 13.9.)

## 10. Labeling

**10.1** Labeling shall conform to ANSI Z129.1.

**10.2** Technical data shall be provided for at least all data elements categorized as "essential" in SSPC-Guide 13.

## 11. Inspection

**11.1** All coatings supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 13.9.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**11.2** Samples of paints under this painting system may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**11.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 12. Disclaimer

**12.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**12.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 13. Notes

Notes are not requirements of this specification.

**13.1** The alkyd coating system described may be suitable on hand cleaned steel. Consult manufacturer for performance or other data supporting this usage.

**13.2** SSPC Environmental Zones covered in this specification are as follows:

| | |
|---|---|
| Zone 1A: | Interior, normally dry (or temporary protection). Very mild (oil base coatings now last six years or more). |
| Zone 1B: | Exteriors, normally dry (includes most areas where oil base coatings now last six years or more). |
| Zone 2A*: | Frequently wet by fresh water. Involves condensation, splash, or spray. (Oil base coatings now last five years or less.) |
| Zone 2B*: | Frequently wet by salt water. Involves condensation, splash, or spray. (Oil base coatings now last three years or less.) |

* Zones 2A and 2B have been modified to exclude immersion.

**13.3 VOC Content:** Each coating, after recommended thinning, must conform to published government regulations regarding volatile organic compound (VOC) content. VOC information should be supplied on the label or the technical data sheet. Various governmental agencies may have different VOC limits or use different methods of testing. The owner may modify this specification as necessary to specify a particular VOC content consistent with local regulations. Coatings meeting the composition and performance requirements of this specification usually have a maximum VOC level of 450 g/L (3.8 lb/gal).

**13.4** Methods of cleaning considered better than SSPC-SP 6/NACE No. 3 include SSPC-SP 5/NACE No. 1 and SSPC-SP 10/NACE No. 2. In some instances, SSPC-SP 12/NACE No. 5 and SSPC-SP 11 have been shown to perform comparably with SSPC-SP 6/NACE No. 3. Pickled surfaces (SSPC-SP 8) and surfaces cleaned by water jetting (SSPC-SP 12/NACE No. 5) may not have a sufficiently high profile or surface roughness to meet the coating manufacturer's requirement.

**13.5** ASTM A 36 steel is frequently used; however, the specifier should be aware that ASTM A 36 steel may vary in chemical composition and hardness, which can affect blast profile and corrosion resistance

**13.6** Standard practices for automatic spray machine application as well as for hand held spray gun application are given in ASTM D 823.

Provided by : www.spic.ir Licensee: NISOC Library

**13.7** Coating thickness measurement by the technique described in SSPC-PA 2 compensates for variation in surface profile and results in the coating thickness being measured above the magnetic average of the peaks of the anchor pattern.

**13.8** Smaller size blisters are not considered to be as detrimental as larger blisters. Hence, a rating of No. 8 Few would be better than a rating of No. 6 Few.

**13.9 QUALITY ASSURANCE TESTS:** The quality assurance tests are used to determine whether the supplied products are of the same type and quality as those originally tested and certified for acceptance. The selected tests should accurately and rapidly measure the physical and chemical characteristics of the coating necessary to verify that the supplied material is substantially the same as the previously accepted material. All of the quality assurance tests must be performed on the originally submitted qualification sample. The results of these tests are used to establish pass/fail criteria for quality assurance testing of supplied products.

**13.9.1 Establishing Quality Assurance Acceptance Criteria:** Many ASTM test methods contain precision and bias statements. Specification developers should be cognizant of the fact that these statements exist. Quality assurance test criteria should not be more stringent than the interlaboratory precision of the test methods used. For example a common quality assurance test is weight per gallon as measured by ASTM D 1475. The interlaboratory reproducibility at the 95% confidence level tells us that any two measurements that differ by more than 1.8% should be considered suspect. This only represents the precision of the measurement technique and does not account for normal variances in the manufactured product. A reasonable estimate for this batch to batch variance might be 2%. The batch to batch variance and the potential variance attributable to the measurement technique are additive. A paint that was originally accepted with a weight per gallon of 10 pounds would therefore be acceptable within the range 9.62 to 10.38 pounds per gallon (10 + 3.8%).

Example: A common quality assurance test is density (weight per gallon) as measured by ASTM D 1475. The interlaboratory reproducibility at the 95% confidence level tells us that because of errors associated with the method, any two measurements of the same material can differ by as much as 1.8%, without the measurements being considered suspect. This only represents the precision of the measurement technique and does not account for normal variances in the manufactured product.

The acceptable range for paint density must be stated. For example, a composition specification may state this requirement as 10.0 ± 0.2 lb/gal, 10.0 lb/gal ± 2%, or as a range from 9.8 to 10.2 lb/gal. The manufacturer of proprietary products should provide this information. Using these values, if the manufacturer's lab measures the density to be 9.8 lb/gal, the product meets the specification and the paint is shipped to the job. Because of the lab to lab variation of 1.8%, the user's lab may measure the density of this sample to be as low as 9.8 less 1.8% of 9.8 (equals 9.6) lb/gal. Similarly for the high end, the manufacturer may measure density of 10.2 lb/gal while the user measures 10.2 plus 1.8% of 10.2 (equals 10.4) lb/gal. The pass/fail criteria for the user to accept a batch of paint should therefore be 9.6 to 10.4 lb/gal.

Where precision and bias data are not available for a given test method, determine the standard deviation of a minimum of five measurements taken on the originally tested and certified material. The pass/fail criterion is that the measurement of the test sample shall fall within two standard deviations of the target value. The contracting parties must agree on a target value.

**13.9.2 Recommended Quality Assurance Tests:** Recommended quality assurance tests include but are not limited to, infrared analysis (ASTM D 2621), viscosity (ASTM D 562), weight per gallon (ASTM D 1475), total solids (ASTM D 2369), dry time (ASTM D 1640), percent pigment (ASTM D 2371), gloss (ASTM D 523), color (ASTM D 1535), condition in container (Fed. Std. 141, Method 3011), and odor (ASTM D 1296).

**13.10** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**13.11**. Table 1 gives a summary of the various tests required in this specification.

Provided by : www.spic.ir Licensee: NISOC Library

**Table 1**
**Summary of Tests**

| Test | PS 27.00 Section | ASTM Standard | Substrate | Panel Size (minimum) | No. of Panels | Minimum Criteria | | |
|---|---|---|---|---|---|---|---|---|
| **Laboratory Physical Tests** | | | | | | | | |
| Flexibility | 7.1 | D 522 | thin gage steel | 100 x 150 mm (4 x 6 in) | 3 | minimum 28% elongation (Method A)<br>pass 3.2 mm (1/8 in) mandrel bend (Method B) | | |
| Hardness | 7.2 | D 3363 | thin gage steel | varies | 3 | 3B pencil hardness | | |
| Gloss | 7.3 | D 523 | thin gage steel | varies | 1 | flat - 85° specular gloss 10 maximum<br>semigloss - 60° specular gloss 30 to 60<br>gloss- 60°specular gloss over 60 | | |
| Adhesion | 7.4 | D 3359 | blast cleaned steel | 75 x 150 x 3.2 mm (3 x 6 x 1/8 in) | 1 | 5A for Method A<br>5B for Method B | | |
| **Accelerated Laboratory Weathering Tests** | | | | | | **Rust, SSPC-VIS 2** | **Blister, ASTM D 714** | **Scribe*** |
| Condensing Humidity (500 h) | 8.1 | D 4585 | blast cleaned steel | 75 x 150 x 3.2 mm (3 x 6 x 1/8 in) | 3 | 9 | 8 Few | none |
| Cyclic Salt Fog/UV (1008 h) | 8.2 | D 5894 | blast cleaned steel | 75 x 150 x 3.2 mm (3 x 6 x 1/8 in) | 3 | 9 | 10 (no blisters) | U≤12 mm |

* Scribe undercutting parameter U = x' + 2s where x' is the mean maximum undercutting and s is the standard deviation

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC: The Society for Protective Coatings
# COMMENTARY ON PAINT SPECIFICATIONS

## 1. Description

Since 1955, SSPC has issued specifications for coatings that have performed well in actual use on steel structures. When these paint specifications are used in conjunction with the SSPC specifications for surface preparation, paint application, and thickness measurement, they provide complete paint systems for most steel structures and environments. Tables 1 and 2 summarize the SSPC paint specifications. Each paint specification contains a scope, a description of the paint, and directions for use.

## 2. Approaches to Procuring Paint

Procurement of paint by specification represents an attempt by the purchaser to exercise a degree of control over the quality of the product. That degree of control may range from tight, as when one of the SSPC paints with a composition specification is cited, to little control, as when a minimally descriptive, generic designation is used (e.g., a zinc-rich primer, a shop coat, a urethane). In addition to purchaser control, specifications make competitive procurement practical.

Another approach to the purchase of paint is represented by specifying the brand name, the composition of which may be described in a label analysis. Usually the citation of a brand name denotes a high degree of confidence in that product's performance record. It also implies confidence in the manufacturer's reputation for quality and integrity — in other words, there's a good chance that the manufacturer will continue to maintain the quality for which the product has become known.

A limitation to the specification by product name is that it does not allow for competitive bidding. This may result in the purchaser paying a premium price for a material although it may be a good material.

Unfortunately, in a vain attempt to promote competition, faith in the performance expected of a known proprietary product is often undermined by addition of the bland phrase "or equal." Adding an "or equal" provision to a procurement specification without specifying real criteria for comparison is technically unjustifiable.

Composition specifications offer the assurance of a desired measure of quality, but they also have the disadvantage of "locking in" a product to the level of quality or value prevailing during a specific period in the history of an evolving technology. One of the objectives of SSPC is to focus on the expertise of its highly qualified, voluntary collaborators (i.e., technical committee members) on critical evaluations of new generic products, so these products may be added to the list of reliable materials.

While no organization deliberating by consensus can operate at a rapid pace, the background of information generated by a mature organization such as SSPC presents the user with enough choices of time-tested paints, both old and new, to justify deferral of judgment on commercial products that are not as yet backed by documented proven performance in the field.

If a paint is procured through a pure composition specification, SSPC-Paint 16 for example, the purchaser knows the physical, chemical, and performance properties of the product. The manufacturer thus follows the formula to produce the paint.

If paints are not being supplied to a composition specification, the purchaser is entitled, without transgressing into the area of proprietary information, to request a statement of the product's principal composition and performance parameters, such as the following:

- Case histories of field performance
- Performance in combination cyclic salt fog/UV condensation tests and condensing cabinet tests
- Non-volatile content by weight and volume
- Volatile organic compound (VOC) content
- Viscosity range at a specified temperature
- Viscosity reduction resulting from specification dilution ratios with thinners
- Spreading rate for complete hiding
- Specific resistance properties where resistance to unusual chemical exposures is required
- Special or unusual drying time requirements
- Suitability for one or another type of application, such as brushing, airless spray, etc.
- Lightfastness rating of the color pigments
- Chalk resistance and gloss retention rating (for topcoats) under specified conditions of test at named exposure locations for indicated periods of time

While not all of these criteria may be important in specific circumstances, they are indicative of the kind of questions that any discriminating purchaser should ask any manufacturer who is supplying paint for exterior exposure. If a purchaser believes that there are no specification paints available that exactly fit his requirements, or if the purchaser feels that he would like to have a better paint than can be obtained from among the available specification paints, he may engage a qualified professional consultant to secure informed and objective guidance.

Provided by : www.spic.ir Licensee: NISOC Library

## TABLE 1
## SSPC PAINTS

| PRIMER | DESCRIPTION | PIGMENT | APPROX. Wt. % PIGMENT | VEHICLE SOLIDS | APPROX. SET TO TOUCH (hr) | DRY THROUGH (hr) | MINIMUM SURFACE PREP. RECOMMENDED | % VOLUME SOLIDS |
|---|---|---|---|---|---|---|---|---|
| SSPC-Paint 5 | Zinc dust primer for fresh water immersion when steel is cleaned to bare metal. Excellent for high humidity or contaminated atmosphere. | Zinc dust 80% Zinc oxide 20% | 75 | Phenolic varnish | 2 | 6 | Commercial blast | 60 |
| SSPC-Paint 8 | A vinyl-aluminum primer; may be used over bare steel, or wash primer, or over other vinyls. Suitable for very severe neutral exposures and immersion. | Aluminum 100% | 6.7 | Vinyl | 0.25 | 1 | Near-white blast or pickling | 14 |
| SSPC-Paint 9 | Vinyl primer similar to above. Recommended for alkaline or acidic exposure. | Titanium dioxide 95% min., tint 5% max. | 12 | Vinyl | 0.25 | 0.5 | Near-white blast or pickling | 17 |
| SSPC-Paint 11* | A general purpose red oxide-chromate primer for structural steel exposed in the atmosphere; good quality. Not recommended for long exposure in severe conditions without topcoat. Slow drying. | Iron oxide 40% zinc yellow 40% extender 20% | — | Raw linseed oil and alkyd varnish (equal parts) | 6 | 24 | Hand cleaning | 70 |
| SSPC-Paint 12 | A filled asphalt mastic coating applied in thick layers over steel. Requires special high pressure spray equipment or brush. | Inorganic filler | — | Asphalts | 4 | 72 | Commercial blast | 50 |
| SSPC-Paint 15 | Fast-drying shop paints for temporary protection of steel joists; performance based. | Not specified | — | Not specified | — | — | Hand cleaning | — |
| SSPC-Paint 16 | Two-component coal tar epoxy self-priming paint for water immersion, chemical, and underground. | Magnesium silicate or iron oxide | 31 | Coal tar pitch and polyamide and epoxy resins | — | — | Commercial blast | 75 |
| SSPC-Paint 17 | Chlorinated rubber inhibitive primer for nonsubmerged surfaces and most submerged surfaces. | Rust inhibitor 65%, extender 35% | 29-49 | Chlorinated rubber 66%, chlorinated plasticizer 34% | 0.25 | 1 | Commercial blast | 32 |
| SSPC-Paint 18 | Chlorinated rubber intermediate paint (or topcoat) in white or tints. | Titanium dioxide 75%**, magnesium silicate 15%, mica 10% | 16-30 | Chlorinated rubber 75% chlorinated plasticizer 25% | 0.25 | 1 | Commercial blast | 35 |
| SSPC-Paint 19 | Chlorinated rubber topcoat in white or tints. | Various | 18-28 | Chlorinated rubber 72% Chlorinated plasticizer 28% | 0.25 | 1 | Commercial blast | 35 |
| SSPC-Paint 20 | | | | | | | | |
| Type I | Inorganic zinc-rich primer | Zn Level 1 ≥ 85% Zn Level 2 77 to 85% Zn Level 3 65 to 77% | Varies | Not Specified | — | — | Commercial blast | — |
| Type II | Organic zinc-rich primer | | | | | | | |
| SSPC-Paint 21 Type I high gloss Type II med. gloss | Highly weather resistant white or colored silicone-alkyd paint suitable for finish coat. | Various | Type I, 11-37 Type II, 29-48 | Silicone alkyd | 2 | 8 | Commercial blast | 60-67 |
| SSPC-Paint 22*** | Primer—Two-component polyamide epoxy primer for industrial exposure marine environment and some chemical exposure. | Red iron oxide, magnesium oxide, mica | 46 | Epoxy/polyamide 65/35 | 2 | 8 | Commercial blast | 65 |
| | Intermediate—Two-component polyamide epoxy intermediate coat. | Red iron oxide, magnesium oxide, mica | 40 | Epoxy/polyamide 65/35 | 2 | 8 | Commercial blast | 65 |
| | Topcoat—Two-component polyamide epoxy topcoat. | Titanium dioxide, chromium oxide, magnesium silicate, mica, lampblack | 36 | Epoxy/polyamide 65/35 | 2 | 8 | Commercial blast | 60 |
| SSPC-Paint 23 | Air drying latex primer and intermediate coat for blast cleaned steel. | Not Specified | Not Specified | Latex | 4 | 24 | Commercial blast | 36 |
| SSPC-Paint 24 | Air drying semi-gloss latex topcoat. | Not Specified | Not Specified | Latex | 4 | 24 | Commercial blast | 27 |

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1 (continued)**
**SSPC PAINTS**

| PRIMER | DESCRIPTION | PIGMENT | APPROX. Wt. % PIGMENT | VEHICLE SOLIDS | APPROX. SET TO TOUCH (hr) | DRY THROUGH (hr) | MINIMUM SURFACE PREP. RECOMMENDED | % VOLUME SOLIDS |
|---|---|---|---|---|---|---|---|---|
| SSPC-Paint 25<br>Type I<br>Type II | Zinc oxide oil and alkyd primer for hand cleaned steel.<br>Type II has lower VOC content than Type I. | Zinc oxide (French process), red iron oxide, magnesium silicate, mica | Type I, 52<br>Type II, 54 | 50/50 raw linseed oil/ long oil alkyd | 20 | 36 | Hand cleaning | Type I, 65<br>Type II, 70 |
| SSPC-Paint 25 BCS<br>Type I<br>Type II | Zinc oxide oil and alkyd primer for blast cleaned steel.<br>Type II has lower VOC content than Type I. | Zinc oxide (French process), red iron oxide, magnesium silicate, mica | Type I, 52<br>Type II, 54 | Type I, 34/66 raw linseed oil/ alkyd; Type II, 33/67 raw linseed oil/alkyd | 6 | 18 | Commercial blast | Type I, 82<br>Type II, 86 |
| SSPC-Paint 26 | Very slow drying black one-coat maintenance primer. | Zinc oxide (French process) 16%, basic lanolate 4%, magnesium silicate 75%, lampblack 5% | 54 | 80/20 Raw linseed oil/long oil alkyd | 24 | 168 | Hand cleaning | 87 |
| SSPC-Paint 27* | Wash primer for clean steel free of rust and scale or for clean galvanized metal. | Basic zinc chromate | — | Vinyl butyral | 0.5 | 4 | Commercial blast | 10 |
| SSPC-Paint 28 | Water-borne epoxy primer for steel surfaces. | Not specified | — | — | — | — | — | — |
| SSPC-Paint 29 | Zinc dust sacrificial primer, performance-based. | Min. 65% zinc in dry film | — | — | — | — | — | — |
| SSPC-Paint 30 | Weld-through inorganic zinc primer. | Zinc dust min. 65% by wt of total solids | — | Water or solvent-reducible, self-curing | — | — | — | — |
| SSPC-Paint 31 | Single-package, water-borne alkyd primer, performance-based. | — | — | Ambient drying, single-package | 8 | 24 | — | — |
| SSPC-Paint 32 | Coal-tar emulsion coating. | — | — | — | — | — | — | 40 |
| SSPC-Paint 33 | Coal-tar mastic, cold applied. | — | — | — | — | — | — | 70 |
| SSPC-Paint 34 | Water-borne epoxy topcoat. | Not specified | — | — | — | — | — | — |
| SSPC-Paint 35<br>Type I<br>Type II | Zinc oxide and medium oil alkyd primer for blast cleaned steel (air dry or low bake).<br>Type II has lower VOC content than Type I. | Zinc oxide (French process), red iron oxide, magnesium silicate, mica | Type I, 41<br>Type II, 55 | Medium oil alkyd | 7 (air dry) | 18 (air dry)<br>0.75 (bake) | Commercial blast | Type I, 37<br>Type II, 66 |

*These paints include chromate containing pigments. Users are urged to follow all health, safety, and environmental requirements in applying, handling, or disposing of these materials.
**These pigment compositions are from a control formula.
***These pigments listed are for use in reference (or control) paint. A lead and chromate-free pigment may be used provided it meets performance requirements.

## 3. Current SSPC Specification Trends

**3.1 COMPOSITION AND PERFORMANCE:** In many of the current SSPC specifications, an attempt is made to combine the advantage of composition requirements, performance criteria, and availability from proprietary sources.

For two reasons there is still a need for some compositional requirements in most paint or coating specifications. First, the correlation between long-term durability and short-term accelerated performance tests is still an incomplete one, in spite of considerable recent progress. Secondly, in the present state of the art, it is still essential for the buyer to know, for example, that a zinc-rich paint contains at least some zinc, and that an epoxy contains some epoxy.

In addition, SSPC has incorporated into some specifications (such as SSPC-PS 12.01, a zinc-rich system) the requirement that the supplier must present documented evidence that the paint system in question has, in fact, provided suitable performance in similar environments, and that the applicator has had successful experiences in applying the paint system in question.

**3.2 PERFORMANCE LEVELS:** Several specifications, (e.g., SSPC-Paint 34, a waterborne epoxy; SSPC-Paint 29, a zinc dust primer; and SSPC-PS 24.00, a latex painting system) have incorporated the concept of performance levels of paints and painting systems. The higher the level, the higher the degree of confidence in the performance of the paint. Under this approach, a lower level is generally based on accelerated tests, which can be performed relatively rapidly, but which offer a lower degree of confidence. The second or third levels of performance are based on actual exterior exposure of 12 to 48 months at defined exterior sites. In some instances, a low level may be used as an interim qualification. In this case, the specifier would accept the products for limited use while waiting to accumu-

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**SSPC ALKYD AND VINYL INTERMEDIATE AND FINISH PAINTS**

| FINISH PAINT | PIGMENT | APPROX. Wt. % PIGMENT | VEHICLE SOLIDS | DENSITY (lb/gal) | DENSITY (kg/L) | APPROX. SET TO TOUCH (hr) | APPROX. DRY TOUCH (hr) | REMARKS |
|---|---|---|---|---|---|---|---|---|
| SSPC-Paint 101 Type I, Leafing Type II, Non-Leafing | Aluminum 100% | 13.3 | Alkyd varnish (long oil) | 8.4 | 1.0 | 4 | 10 | For atmospheric use. Used as aluminum top coat over oil paints or alkyds. Used as barrier coat on bitumens. Type I is usually supplied ready to mix. Type II is supplied ready-mixed. |
| SSPC-Paint 102 | Carbon black 100% | 5.5 | Alkyd varnish (long oil) | 7.7 | 0.9 | 6 | 18 | Very durable black finish coat for oil or alkyd paints. For atmospheric exposure, particularly severe industrial or railroad. |
| SSPC-Paint 103 | Carbon black 40% silica 60% | 12.5 | Phenolic varnish | 8.8 | 1.1 | 4 | 12 | Fume and acid resistant black phenolic; good for water immersion, condensation, and mild chemical; used over phenolic paint preferably, but may be used over hard oil or alkyd paints. |
| SSPC-Paint 104 | | | | | | | | |
| Type I, White | Titanium dioxide 67%, extender 33% | 47.5 | Alkyd varnish (long oil) | 11.6 | 1.4 | 6 | 18 | White, inert pigmented, alkyd finish paint for use over oil or alkyd paints. |
| Type II, Medium to Light Gray to Tan | Titanium dioxide 26%, extender, tint 74% | 42.4 | Alkyd varnish (long oil) | 10.7 | 1.3 | 6 | 18 | Color to be specified. For use over oil or alkyd paint. Colorfast. |
| Type III, Light or Gray Green | Titanium dioxide 25% extender, tint 75% | 44.8 | Alkyd varnish (long oil) | 11.6 | 1.4 | 6 | 18 | Color to be specified. For use over oil or alkyd paint. Colorfastness good, but depends upon tinting pigments used. |
| Type IV, Dark or Forest Green | Chrome green 90%, extender, tint 10% | 21.5 | Alkyd varnish (long oil) | 9.0 | 1.1 | 6 | 18 | Very dark chrome green alkyd paint. Colorfastness good in mild atmospheres, but poor in chemical exposure. |
| SSPC-Paint 106 | Carbon black 100% | 1 | — | 7.4 | 0.9 | 0.25 | 0.5 | Black vinyl finish paint. Use over vinyls only or over wash primers. Very good resistance to most exposures. |
| SSPC-Paint 108 | Aluminum paste | 17 | Thixotropic alkyd | — | — | 4 | 16 | High-build thixotropic aluminum leafing paint, 49% volume solids. |

Provided by : www.spic.ir Licensee: NISOC Library

late the field data required for the higher level of performance.

**3.3 VOC LEVELS:** In response to the continuing awareness of protecting the environment, governmental agencies now restrict the emission of volatile organic compounds (VOC) from painting operations. SSPC formerly defined six classes based on VOC emissions, but these have been discontinued because of the wide variation in VOC limits among different localities and among different applications. The contracting parties are now referred to the federal, state, and local regulatory authorities for guidance on the allowable levels of VOC emissions.

## 4. Government Specifications and Standards

There are many federal and military specifications for paint and coating materials. Although both purely compositional and purely performance specifications exist, the majority of government specifications contain both compositional and performance requirements.

In order to speed the procurement process, some government agencies maintain a qualified products list (QPL) of approved suppliers for approved formulations. Qualification requires complete compliance with every requirement within the specification, some of which may include months or even years of exposure testing. The paint may require both laboratory and exposure testing for conformance to specification requirements. The fact that a product has been examined, tested, and placed on a QPL by the preparer of the specification, signifies only that at the time of inspection and test the manufacturer could make a product that met all specification requirements. It in no way relieves the supplier from the obligation to deliver items meeting all requirements.

There is a federal regulation requiring compliance with a mandate from Congress to make greater use of commercial industry standards whenever they will meet the needs of the government because of availability and cost considerations. These standards are described as rules, conditions, or requirements established by commercial standards-setting bodies concerning definition of terms; classification of components; specification of materials, performance, or operations; delineation of procedures; or measurement of quantity and quality in describing materials, products, systems, services, or practices.

There are standard procedures for preparation, updating, and cancellation of federal and military specifications as the need arises. The user is responsible for preparing a specification. The Materials and Mechanics Research Center, which lists all projects in the Federal Standardization Class 8010 for the Department of Defense, establishes projects for each user requesting a project number.

Titles of specifications for paint materials use one key noun (e.g., coating, paint, enamel, compound, etc.) followed by descriptive adjectives (e.g., textured, vinyl, anti-corrosive, etc.). The federal code system for specifications for paint and coating materials usually starts with TT-, followed by the first letter of the type of material (e.g., E for enamel; P for paint; C for coating; etc.) and a number. A letter, starting with A, is added after the number as modifications are made. Thus, TT-E-489F, Enamel, Alkyd, Gloss (For Exterior and Interior Surfaces) is the code and title of the sixth revision of a specification for a commonly used enamel. Specifications for similar materials are sometimes grouped together. Thus, TT-P-300 to TT-P-500 are reserved for pigments. Many of the pigment specifications that previously fell in this category have been replaced by ASTM specifications.

Most of the federal specifications were developed based on commercially available products with a high level of performance. The specifications usually consisted of a combination of performance and formulation requirements. As technology progressed, the raw materials used in commercially available products changed. This resulted in a virtual nonavailability of paints meeting the federal requirements in the marketplace. Manufacturers still had the ability to specially formulate batches of paint that would meet all specification requirements, but this was both costly and time consuming. As a result, in the mid to late 1990's, most of the TT-P-xxx specifications were canceled and the government began making greater use of industry specifications. When no industry specification was available, replacement specifications, called Commercial Item Descriptions (recognized by the designation CID A-A-xxx), were developed using performance requirements to the greatest extent possible. Some of the old federal specification paints are still commercially available, but the government is no longer maintaining the specifications. Some of the DoD-P-xxx specifications are still active. A few discontinued specifications, such as MIL-P-15328, are available from SSPC.

In addition to specifications, there are federal tests (Federal Test Method Standard No. 141) and a few federal standards (e.g., Federal Standard No. 595 Colors) that are available from the Specification Distribution Branch of the GSA. A listing of all such specifications and a Federal Supply Classification listing can be found in the Index of Federal Specifications and Standards, available on a subscription from the Superintendent of Documents (or on the Internet at www.dtic.mil/stinet/str). Single copies of specifications for bidding can be obtained free from any GSA Business Service Center.

Military specifications are distinct from other federal specifications. They are generally written with the prefix MIL- or DoD- (Department of Defense), followed by a code letter designating the type of product and a number assigned to each product. The DoD designation indicates all of the requirements of the specification are in metric. Many of the military specifications describe paints that are unique to the military. Examples might include products such as coatings for ammunition, anti-sweat coatings for use onboard submarines, or coatings that have very low infrared

Provided by : www.spic.ir Licensee: NISOC Library

signatures that will avoid detection by enemy forces. Many of these coatings are not common in the marketplace. These specifications will continue to remain in effect until commercial products become more available. Navy coatings for ships frequently have formula and specification numbers. MIL-P-24441 includes formulas 150 through 156. A few JAN (Joint Army-Navy) specifications, forerunners of the MIL specifications, are still used. Military specifications, standards, and qualified products lists can be obtained from the Naval Publications and Forms Center.

There are a few specifications that have been issued by other federal agencies, such as the Maritime Administration, the Bureau of Reclamation, the Corps of Engineers, and the U.S. Postal Service. These specifications are only used by the issuing agency, and many are being canceled in favor of alternate government or industry specifications. Many of these specifications have been changed to federal or military specifications. Specifications of such groups as SSPC and the American Association of State Highway and Transportation Officials (AASHTO) are also used by federal agencies.

Items that are frequently useful in preparing contracts include paint specifications, guide specifications, type specifications, and Military and Federal Construction Guide Specifications. Purchase descriptions cover items for a single procurement. Type and guide specifications provide information covering a description of services required for construction or maintenance of structures such as bridges, storage tanks, and buildings.

The Department of Defense Index of Specifications and Standards (DODISS) is published annually with cumulative bi-monthly supplements for each part (Part I - Alphabetical Listing; Part II - Numerical Listing). It is available at a subscription rate from the U.S. Government Printing Office. An additional charge is required for foreign mailing. The Federal Supply Classification Listing (a cumulative listing of documents alphabetically within their FSC classes) is also available from the U.S. Government Printing Office at a subscription rate with an additional charge for foreign mailing (available on the Internet at www.dodssp.daps.mil.) Another useful Internet source for government specifications is Assist Online at http://astimage.daps.dla.mil/online/.

## 5. Other Paint Specifications and Standards

In addition to the Federal Government, many other agencies, both public and private, issue paint specifications. SSPC refers to other useful public specifications whenever they are available, and has also cooperated in preparing many private specifications for special purposes. Organizations that issue standards related to painting steel are listed below. A more complete list with addresses, phone/fax numbers, and email addresses can be found in the appendix at the end of this volume.

- The American Society for Testing and Materials (ASTM) has been extremely active in preparing specifications for paint materials and for standard test methods for paints and materials. A complete index of all ASTM standards, listed by title, is available from ASTM at www.astm.org.
- The American National Standards Institute (ANSI) has issued a number of specifications concerning safety precautions to be maintained in cleaning and painting and in the use of toxic materials. An index to their standards may be procured free or found on the Internet at www.ansi.org.
- The Canadian Government Specifications Board (CGSB) has issued a number of specifications dealing with paints, cleaning and painting materials. An index is available on the Internet at www.pwgsc.gc.ca.
- The British Standards Institution (BSI) has issued a number of applicable specifications. A list of BSI standards can be found on the Internet at www.bsi.org.uk.
- The American Water Works Association (AWWA) has issued specifications for the painting of water tanks and also for coating of pipelines. AWWA's Internet address is www.awwa.org.
- The American Association of State Highway and Transportation Officials (AASHTO) has issued specifications for paints and the painting of highway bridges and other structures. AASHTO's Internet address is www.aashto.org.
- The American Welding Society (AWS) issues standards relating to safety practices, application, and materials for welding. AWS's Internet address is www.aws.org.

## 6. Other Generic Types of Paints and Coatings

A number of special coatings have not been fully covered in the SSPC painting systems. Because of the considerable interest in these materials, they will be discussed briefly here. Many of these are available under Federal or Military specifications. Excellent proprietary products are available for all of them. In every case, the directions of the manufacturer should be followed for application and use. Some of the principal generic types are listed below alphabetically.

**6.1 COAL TAR COATINGS:** Coal tar has been used to make hot- and cold-applied protective coatings for more than a century. The solvent dispersed cold coatings, known as cutbacks, may be filled or unfilled. Hot applied enamels are used over cutback coal tar primers or synthetic quick dry primers. Coal tar coatings have excellent water resistance and are, therefore, very suitable for water immersion

Provided by : www.spic.ir Licensee: NISOC Library

or underground usage. They have poor resistance to ultraviolet light unless topcoated with a coal tar emulsion. A coal tar cutback without filler, which results in a comparatively thin dry film, is covered by Bureau of Reclamation Specification CTP-3, Coal Tar Paint. Thick film mastic type coal tar coatings are covered by Bureau of Reclamation Specification CA-50 and MIL-C-18480. The filled type coatings described in MIL-C-18480 are covered by SSPC-Paint 33.

AWWA Specification C 203 for coal tar primers, synthetic primer, enamels, and cutbacks are extensively used in potable water systems, tanks, and pipelines. See SSPC-PS 10.01 and 10.02.

**6.2 EPOXY MASTICS:** Epoxy mastics are usually used in situations where blast cleaning is prohibited or where the degree of blast cleaning is less than desirable. In other words, they serve as a surface tolerant coating going over marginally cleaned surfaces and most weathered coatings. In many instances, epoxy mastics have been specified in place of red lead alkyds for use over hand-cleaned steel.

Epoxy mastics are typically high solids, low VOC coatings that can be applied in thick coats by brush, roller, airless, or air spray. Typical thickness is 100 to 175 micrometers (4 to 7 mils) per coat. They can serve as a primer/topcoat or as a primer for epoxy, chlorinated rubber, vinyl, or urethane topcoats. These coatings are not recommended for immersion service.

Although SSPC does not have an epoxy mastic paint specification, per se, there is an aluminum epoxy painting system that can be used over hand cleaned or blast cleaned steel. This performance based painting system, SSPC-PS 26.00, "Aluminum Pigmented Epoxy Coating System for Steel Surfaces, Performance-Based," can be found in Chapter 3.

**6.3 GREASE PAINTS:** In SSPC's experience, grease paints have been used with only mixed results. They give temporary protection in mild areas at low initial cost. They have considerable ease of application, especially in inaccessible spots. The protection they have afforded, however, has not been equal to that of the hard-drying types of paints. Difficulty of inspection, appearance, lack of hiding, and slipperiness are further limitations.

**6.4 HIGH-TEMPERATURE SILICONE BASED COATINGS:** The type of coating required will depend upon the desired color and pigmentation, the maximum temperature reached by the substrate, and whether operation at this temperature is intermittent or continuous. In addition to providing protection at elevated temperatures, the coatings should provide protection from the effects of weather between periods of heating.

The substrate should be cleaned of all oil, grease, and other contaminants. For best results, blast clean the surface to at least SSPC-SP 10 (near-white). The surface profile should not be more than half of the total dry film thickness. If a primer is used to enhance adhesion between the substrate and topcoat or for increased protection under damp or chemically corrosive environments, the primer must also be heat resistant. The need for and choice of primers are based on the projected service environment.

The choice of specific paints for specific jobs will depend on operation conditions and service properties desired. The application temperature should be from 10 to 49°C (50 to 120°F). The cure required will vary from room temperature with unspecified time to specified elevated temperature and/or cure time. The paint supplier should be contacted for specific cure requirements.

At operating temperatures between 120°C and 320°C (250°F and 600°F) a total dry film thickness between 100 to 150 micrometers (4 to 6 mils) is suggested. Between 320°C and 650°C (600°F and 1200°F) a total dry film thickness of 25 to 100 micrometers (1 to 4 mils) is recommended. The specific dry film thickness recommendations should be obtained from the coating manufacturer's literature. General guidelines are given in Table 3.

In the pigmentation of heat-resistant paints, it is important to use heat-resistant pigments. The majority of paints formulated to tolerate exposure above 260°C (500°F) use inorganic or metallic pigments. The following specifications are currently available:

| | |
|---|---|
| **TT-P-28** | Paint, Aluminum, Heat Resisting (1200°F, 650°C). |
| **MIL-P-14105** | Paint, Heat Resisting (For Steel Surfaces) |

The aluminum paint in TT-P-28 must contain some silicone and protect the substrate to 650°C (1200°F). The silicone ceramic paint in MIL-P-14105 must perform at temperatures up to 760°C (1400°F).

**6.5 MASTICS:** These heavy coatings, usually 6 mm (0.25 inch) or more in dry film thickness, provide a thick, impervious barrier coat that excludes moisture and vapors. Common types are based upon bitumens, oils, low molecular weight vinyls, other synthetic resins, natural resins, or synthetic rubber. They are often used with a filler of a thixotropic agent to provide heavy film thickness and very high solids.

**6.6 METALLIZING:** Sprayed metal coatings are discussed in detail in Volume 1 of the SSPC Painting Manual and in SSPC-CS 23.00(I), "Interim Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel". Metallizing is a subset of thermal spraying wherein a metal feedstock material is heated, atomized, and the molten particles propelled to the substrate forming the thermal spray coating (TSC). The thermal spray gun generates the necessary heat by using combustible gases or an electric arc. As the materials are heated, they are changed to a plastic or molten state and

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 3**
**COATING SYSTEM TYPE FOR VARIOUS TEMPERATURE* RANGES**

| TEMPERATURE (°C) | TEMPERATURE (°F) | COATING SYSTEM TYPE |
|---|---|---|
| 120 to 200 | 250 to 400 | Silicone-modified organic (colored) |
| 200 to 320 | 400 to 600 | Silicone-modified organic (aluminum);<br>Silicone-modified organic (colored);<br>Organic-modified silicone (colored) |
| 320 to 430 | 600 to 800 | Organic-modified silicone (black and aluminum);<br>Silicone (colored) |
| 430 to 540 | 800 to 1000 | Silicone (black);<br>Silicone (aluminum) |
| 540 to 760 | 1000 to 1400 | Silicone ceramic;<br>Silicone-modified organic 15-10% silicone;<br>Organic-modified silicone 50-90% silicone |

* 100 hours minimum

are confined and accelerated by a compressed gas stream to the substrate. The particles strike the substrate, flatten, and form thin platelets (splats) that conform and adhere to the irregularities of the prepared substrate and to each other. As the sprayed particles impinge upon the surface, they cool and build up, splat by splat, into a laminar structure forming the TSC. The bond between the substrate and the coating is primarily mechanical. The properties of the applied coating are dependent on the feedstock material, the thermal spray process and application parameters, and post-treatment of the applied coating. The application of TSCs emits no volatile organic compounds, needs no drying time, and can be applied in low- and high-temperature environments.

**6.6.1 Zinc and Aluminum TSCs:** Zinc, aluminum, and zinc-aluminum alloy coatings are used for a wide variety of corrosion-control applications in industrial and marine environments. They provide significant corrosion protection, up to and greater than 20 years to first maintenance. They are anodic to steel, providing sacrificial protection and, when applied in a non-through porosity thickness, also providing barrier protection. In this respect zinc is a much more active metal than aluminum. On the other hand, aluminum has a lower chemical activity, an adherent oxide film, and a higher electrical resistance than zinc. Aluminum also provides longer term protection along with better high-temperature and abrasion/wear resistance. Alloys of the two metals have properties somewhere in between, depending on the ratio of zinc to aluminum. An 85/15 (percent by weight) alloy of zinc and aluminum is a widely used TSC material because it combines attributes from both metals. The 85/15 Zn/Al applied on an SSPC-SP 10 (near-white blast) finish is estimated to reach 5 to 15% degradation in a severe marine environment in 30 years.

**6.6.2 Arc and Flame Spraying:** Arc- and flame-wire spraying are the primary methods for metallizing steel components and structures. In arc spraying, two insulated consumable electrodes, at 18 to 40 volts potential difference, advance to meet in an atomizing gas stream. The high-temperature arc heat source melts the wires and a compressed air stream atomizes and propels the molten particles to the substrate forming the TSC. In flame spraying, the wire advances through an oxygen fuel-gas heat source melting the wire. A compressed air stream atomizes and propels the molten particles to the substrate forming the TSC. Arc spraying is generally more cost-effective than flame spraying providing higher spray rates and lower energy costs.

**6.6.3 Sealing and Painting:** Aluminum and zinc TSCs have porosity ranging up to 15 percent. Interconnected porosity may extend from the surface to the substrate. Sealing extends the service life. Sealing is accomplished two ways: (1) naturally, by the oxidation of the sprayed aluminum or zinc filling the pores with a tightly adherent oxide layer; or (2) by applying a thin low-viscosity paint sealer coating that penetrates and is absorbed into the pores of the TSC. Sealers should be applied before significant natural oxidation occurs. Liquid seal coats must be suitably thinned and have a fine-pigment grind to effectively flow into the TSC. Sealers improve the appearance and reduce the retention of dirt and other contamination, but they do not degrade the cathodic protection of the TSC. Sealed TSCs should be painted only when:

- The environment is very acidic or very alkaline, i.e., when the pH is outside the range of 5 to 12 for zinc and zinc alloy TSCs or 4 to 9 for aluminum TSCs.
- The metal is subject to direct attack by specific chemicals.
- The required decorative finish can be obtained only with paint.
- Additional abrasion resistance is required.

Provided by : www.spic.ir Licensee: NISOC Library

Common sealers include many of the synthetic resin coating systems, especially vinyls, epoxies, polyurethanes, and phenolics. High-viscosity, thick film coatings should never be applied directly to an unsealed thermal spray coating.

When TSCs are applied as a sacrificial anode, a liquid seal coat is usually not used. However, a very thin liquid seal coat may be used if it is less than 25 micrometers (1 mil) thick. This will maintain the electrical path between the TSC and the substrate steel. When TSCs are applied as a distributed anode for an impressed current cathodic protection system, a liquid sealer or topcoat should not be applied.

**6.7 NON-SKID COATINGS:** Any type of paint that is suitable for application on floors can be converted to a skid resistant paint by incorporation of a finely divided material such as silica, aluminum oxide, or ground shells. Two Federal performance specifications are A-A 59124, Deck Covering, Lightweight, Nonslip, and A-A 59166, Coating Compound, Nonslip (for Walkways). These paints, in addition to providing high friction surfaces, must have weather and impact resistance.

**6.8 NEOPRENE:** Neoprene is a synthetic elastomer which is soluble in aromatic hydrocarbons and is used as a vehicle for protective coatings. It has high elasticity, good aging, and chemical and solvent resistance. The proprietary neoprene coatings may be divided into two general types: (a) two-part high solids heavy duty coatings and (b) one-part self-priming coatings.

The two-part high solids coatings, which are usually based on “Neoprene KNR,” have comparatively poor adhesion even to blast cleaned steel and are generally used over chlorinated rubber primers. They require addition of vulcanizing and accelerating agents prior to application. Typical specifications for such a coating have been proposed: solids content 54 to 58% (of which at least 50% would be neoprene), specific gravity 1.1 to 1.2, viscosity at 25°C (77°F) is 1750 to 2500 centipoise, and a dry film thickness of at least 125 micrometers (5 mils).

Lower solids, self-priming maintenance coatings, usually based on “neoprene AC,” have about as much solids as the heavily liquid neoprene coatings. These coatings contain all curing agents and nothing need be added on the job. They have fair storage stability. The coatings are of the order of 2 mils (50 micrometers) dry film thickness. The neoprene “AC” coatings have less chemical and abrasion resistance than the vulcanized “KNR” coatings.

**6.9 POLYESTER COATINGS:** Polyester vehicles are based upon a condensation reaction between an acid and an alcohol, one or both being unsaturated. The resulting pre-polymer is dissolved in styrene and uses a peroxide catalyst and an accelerator to bring about poly-addition and cross-linking reactions. The styrene solvent reacts with the polyester during curing so that no solvent evaporation is necessary. Depending upon the choice of the catalyst, these products may be cured at room temperature or by baking. A wide range of properties can be obtained by using rigid, semi-rigid, flexible, corrosion-resistant, or fire-retardant resins.

In addition to these conventional polyesters, a fully saturated linear polymer may be obtained, such as that formed from terephthalic acid, suitable for tapes and foils. This type will not be discussed here. Discussed separately under urethanes is the type of polyester that reacts with diisocyanates to form polyurethane.

The common polyesters are almost always reinforced with glass fiber, cloth, asbestos, micaceous pigments, etc., to absorb shrinkage strains and to compensate for the brittle character of the resins. Small amounts of wax may also be added to the polyester at the time of manufacture to overcome its tendency toward air inhibition of the normal curing of the polyester mass.

The polyester may be made up as a two-package system. Mixed shortly before use, one package contains the promoter, such as cobalt naphthenate, and the other the peroxide catalyst or initiator. A three-package system is also available consisting of polyester, catalyst, and promoter. These resins may be applied with a two-nozzle spray gun that mixes the reactive ingredients in the spray pattern. A third nozzle may be used to incorporate short glass fiber into the wet film.

**6.10 POLYETHYLENE COATINGS:** Solid polyethylene has excellent resistance to all chemicals except for strong oxidizing agents, oils, and chlorinated and aromatic solvents. Since this resin is available in powdered form, heavy thicknesses can be applied. It should not be assumed, however, that the coatings have the impermeability of a calendared film of equal thickness. Nevertheless, proper application by fluidized bed or by flame spray can result in a durable, economical, and attractive coating.

The surface is preferably prepared by blast cleaning, and the metal is ordinarily pre-heated to approximately 220°C (425°F) before application of the resin. For corrosive applications, the coating should be tested for pinholes by a static spark tester. Flame spraying tends to oxidize the resin nearest the hot surface, improving adhesion but tending to decrease impermeability and chemical resistance at that point. The coating has excellent anti-stick properties and resistance to a wide range of chemicals.

Although atmospheric weathering of these films is usually good, it will vary considerably with small variations in formulation. Weather durability is similar to that of chemically related alkyds. Water and moisture resistance are excellent and these coatings are widely used in salt and fresh water exposure. Polyethylene coatings adhere well to steel that has been deeply etched or blast cleaned to provide the necessary mechanical roughness.

Provided by : www.spic.ir Licensee: NISOC Library

**6.11 SILICONE ORGANIC COPOLYMERS:** Silicone coatings have been well known for some time for their good color and gloss retention when exposed to exterior weathering. They are discussed under high temperature silicone-based coating. Unmodified silicones, however, are expensive and must be cured at 200-260°C (400-500°F). Air drying properties, lower cost, hardness, and adhesion are obtained by copolymerizing silicones with organic polymers. The copolymers show practically no film erosion and therefore are very slow to chalk.

**6.12 TAPES:** Many kinds of tapes are widely used in the protection of underground piping. Some of these, including vinyl and polyethylene tapes, have also been used in the protection of other kinds of structural steel. Widths range up to several feet; tape may either have pressure sensitive backing or require separate adhesive for application. Some of these tapes have good resistance to weather and brine, if carefully lapped, but have poor resistance to abrasion or cutting. Common types are discussed in the chapter on underground coatings in Volume 1 of the SSPC Painting Manual.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 5
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 5

## Zinc Dust, Zinc Oxide and Phenolic Varnish Paint

### 1. Scope

**1.1** This specification covers a quick drying zinc dust, zinc oxide, and phenolic varnish paint for steel or galvanized surfaces. It has very good rust inhibitive characteristics, but only fair wetting ability for rusting, greasy, or oily surfaces. It has a drying time of about 12 hours, good durability even when weathered before finish coating and may be used for intermediate and finish coats.

**1.2** This paint is supplied in two-package kits: one package contains the liquid vehicle (Component A); the other package contains the zinc dust-zinc oxide pigment (Component B).

**1.3** This paint is suitable for exposure in Environmental Zones 1A (interior, normally dry) and 1B (exterior, normally dry), and is particularly suited for exposure in Environmental Zone 2A (frequently wet by fresh water). It is intended for brush or spray application over steel surfaces prepared in accordance with SSPC-SP 6, "Commercial Blast Cleaning;" SSPC-SP 10, "Near-White Blast Cleaning;" SSPC-SP 5, "White Metal Blast Cleaning;" and SSPC-SP 8, "Pickling;" or over clean galvanized steel.

**1.4** This paint is suitable as a shop primer, field primer, maintenance primer, or intermediate coat and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel." This paint will dry in about 12 hours and should be recoated within 24 hours for optimum intercoat adhesion.

### 2. Description

**2.1** The good weathering ability of this primer is the result of its phenolic varnish vehicle. Details of the composition are given in Table 1.

**2.2** This paint contains approximately 60% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 2.0 mils (51 micrometers) dry film thickness is 480 square feet/U.S. gallon (11.8 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 12** | Specification for Raw Tung Oil |
| **D 79** | Specification for Zinc Oxide Pigments |
| **D 154** | Guide for Testing Varnishes |
| **D 185** | Test Methods for Coarse Particles in Pigments, Pastes, and Paints |
| **D 235** | Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent) |
| **D 331** | Specification for 2-Ethoxyethanol |
| **D 520** | Specification for Zinc Dust Pigment |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 600** | Specification for Liquid Paint Driers |
| **D 801** | Methods for Sampling and Testing Dipentene |
| **D 1208** | Test Methods for Common Properties of Certain Pigments |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1542** | Test Method for Qualitative Detection of Rosin in Varnishes |
| **D 1544** | Test Method for Color of Transparent Liq- |

Provided by : www.spic.ir Licensee: NISOC Library

uids (Gardner Color Scale)
**D 1545** Test Method for Viscosity of Transparent Liquids by Bubble Time Method
**D 1642** Test Methods for Elasticity or Toughness of Varnishes
**D 2369** Test Method for Volatile Content of Coatings
**D 2371** Test Method for Pigment Content of Solvent-Reducible Paints
**D 3278** Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus
**D 3734** Specification for High-Flash Aromatic Naphthas
**D 4400** Test Method for Sag Resistance of Paints Using Multinotch Applicator

**3.6 FEDERAL STANDARDS:**

**A-A-59106** Ethylene Glycol Monoethyl Ether, Technical
**A-A-59107** Toluene, Technical
**A-A-714** Linseed Oil, Alkali Refined
**TT-N-97** Naphtha, Aromatic

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

**Method 2012** Preparation of Tin Panels
**Method 3011** Condition in Container
**Method 3021** Skinning (Partially Filled Container)
**Method 4021** Pigment Content (Ordinary Centrifuge)
**Method 4053** Nonvolatile Vehicle Content
**Method 4061** Drying Time
**Method 4203** Reducibility and Dilution Stability
**Method 4321** Brushing Properties
**Method 4331** Spraying Properties
**Method 4541** Working Properties and Appearance of Dried Film

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

**Z129.1** Hazardous Industrial Chemicals – Precautionary Labeling

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1.

**4.2** Each component of this paint based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. No rosin or rosin derivatives may be used. Beneficial additives such as antiskinning agents, suspending agents, or wetting aids may be added.

**4.3** The phenolic varnish portion of this paint shall conform to the composition requirements of Table 2.

**4.4** The mixed paint shall conform to the composition (analysis) requirements of Table 3.

## 5. Properties

**5.1** The phenolic varnish portion of this paint shall meet the requirements of Table 4 and Sections 5.2 through 5.8.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**TABLE 1**
**COMPOSITION OF THE MIXED PAINT**

| | REQUIRED | | TYPICAL COMPOSITION | | INGREDIENT STANDARDS | |
|---|---|---|---|---|---|---|
| INGREDIENTS | Min. Wt. % | Max. Wt. % | Wt.% | Vol.% | ASTM | Federal |
| PIGMENT: (75 ± 1 wt. %) | | | | | | |
| Zinc Dust | 79 | — | 60.0 | 21.4 | D 520 | — |
| Zinc Oxide | — | 21 | 15.0 | 6.8 | D 79 | — |
| VEHICLE: (25 ± 1 wt. %) | | | | | | |
| Phenolic Varnish | 82.9 | — | 20.7 | 58.0 | — | — |
| Mineral Spirit Thinner | — | 16.5 | 4.1 | 13.4 | D 235 | |
| Driers | — | 0.6 | 0.2 | 0.4 | D 600, Class B | — |
| TOTALS | | | 100.0 | 100.0 | | |



Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**COMPOSITION OF THE PHENOLIC VARNISH**

| | REQUIRED | | TYPICAL COMPOSITION | | | | INGREDIENT STANDARDS | |
|---|---|---|---|---|---|---|---|---|
| INGREDIENTS | Min. Wt. % | Max. Wt. % | Lbs. | (kg) | Gals. | (L) | ASTM | Federal |
| Unmodified Para Phenyl Phenol-Formaldehyde Resin | 16.7 | — | 100.0 | (45.4) | 10.0 | (37.9) | — | — |
| Linseed Oil (Alkali Refined) | 17.1 | — | 103.0 | (46.8) | 13.0 | (49.2) | — | A-A-714 |
| Tung Oil | 26.0 | — | 156.6 | (71.1) | 20.0 | (75.7) | D 12 | — |
| Mineral Spirit Thinner | — | 28.1 | 169.0 | (76.7) | 26.0 | (98.4) | D 235 | |
| Dipentene | — | 4.7 | 28.3 | (12.8) | 4.0 | (15.1) | D 801 | |
| Ethylene Glycol Monoethyl Ether | — | 3.8 | 23.4 | (10.6) | 3.0 | (11.4) | D 331 | A-A-59106 |
| Toluene | — | 2.4 | 14.5 | (6.6) | 2.0 | (7.6) | D 362 | A-A-59107 |
| Naphtha (Aromatic) | — | 1.2 | 7.2 | (3.3) | 1.0 | (3.8) | D 3734 | TT-N-97 |
| TOTAL | 100.0 | | | | | | | |

* The following cooking procedure is intended as a guide only. Heat the resin and the linseed oil to 550°F (228°C) in 50 to 60 minutes. Add the tung oil and reheat to 465°F (241°C) in 15 to 20 minutes. Pull from fire and allow to cool to 420°F (216°C) and thin; add the thinners in the order shown. The finish varnish should be filtered or centrifuged to remove all visible foreign solid material.

**TABLE 3**
**ANALYSIS OF THE MIXED PANT**

| | REQUIREMENTS | | | |
|---|---|---|---|---|
| CHARACTERISTICS | Min. Wt. % | Max. Wt. % | ASTM | FED-STD-141 |
| Pigment | 74 | — | D 2371 | 4021 |
| Volatiles | — | 14 | D 2369 | — |
| Nonvolatile vehicle calculated by difference | 11 | — | — | 4053 |
| Uncombined water | — | 0.5 | D 1208 | — |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 1.5 | D 185 | — |
| Rosin or rosin derivatives | — | 0 | D 1542 | — |

**5.3 COLOR:** The color shall be 10 to 12 (ASTM D 1544).

**5.4 ELASTICITY:** Shall be 130% using the run-kauri method (ASTM D 1642).

**5.5 REACTIVITY:** The phenolic varnish shall be non-reactive (ASTM D 154).

**5.6 SKINNING:** There shall be no skinning in a three quarters filled closed container after 48 hours when tested in the standard manner specified in FED-STD-141, Method 3021.

**5.7 WATER RESISTANCE:** Ten panels prepared in accordance with FED-STD-141, Method 2012 shall be in distilled water at 212°F (100°C) for 7 hours for the hot water test and at 68°F (20°C) for 96 hours for the cold water test. The panels during immersion shall be in a vertical position. A recovery period of two hours shall be allowed before examination of the panel under test. Acceptable specimens shall show no whitening, dulling, or blistering.

**5.8 ALKALI RESISTANCE:** Dip the closed end of a well cleaned 1 by 6 inch (2.5 by 15 cm) test tube to a depth of 4 inches (10 cm) into the phenolic varnish and allow to dry for 72 hours with the mouth of the test tube down. Dip the closed end of the test tube to a depth of 2 inches (5 cm)

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 4**
**PROPERTIES OF THE PHENOLIC VARNISH**

| | REQUIREMENTS | | | |
|---|---|---|---|---|
| **CHARACTERISTICS** | **Min.** | **Max.** | **ASTM** | **FED-STD-141** |
| Viscosity* (Gardner-Holdt) | C-D | — | D 1545 | — |
| Weight per U.S. gallon, pounds | 7.7 | — | D 1475 | — |
| Nonvolatile | 59.0 | 61 | — | 4053 |
| Drying time, hours | | | | |
| Tack free | 1 | 4 | — | 4061 |
| Dry hard | — | 12 | — | 4061 |

*Viscosity 48 hours or more after manufacture.

**TABLE 5**
**PROPERTIES OF THE MIXED PAINT**

| | REQUIREMENTS | | | |
|---|---|---|---|---|
| **CHARACTERISTICS** | **Min.** | **Max.** | **ASTM** | **FED-STD-141** |
| Viscosity* sheer rate 200 rpm | | | | |
| Grams | 150 | 275 | D 562 | — |
| Kreb units | 72 | 92 | D 562 | — |
| Weight per U.S. gallon, pounds | 21.0 | — | D 1475 | — |
| Fineness of grind, Hegman units | 4 | — | D 1210 | — |
| Drying time, hours | | | | |
| Tack free | 1 | 4 | — | 4061 |
| Dry hard | 6 | 12 | — | 4061 |
| Flash point, degrees F | 86 | — | D 3278 | — |
| Sag Resistance, mils | 6 | — | D 4400 | — |

*Viscosity 48 hours or more after manufacture.

below the surface of a 5% caustic soda (NaOH) solution at 68°F (20°C) for 5 hours. After removal, immediately rinse under gently running water being careful not to touch the treated film. Dry for two hours and examine under suitable light. Acceptable specimens shall show no visible dulling, checking, or blistering. Defects at the extreme bottom of the test tube shall be disregarded.

**5.9** The mixed paint shall meet the requirements of Table 5 and Sections 5.10 through 5.12.

**5.10 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the mixed paint when two volumes of the paint are slowly mixed with one volume of mineral spirits (FED-STD-141, Method 4203).

**5.11 WORKING PROPERTIES:** The mixed paint shall be easily applied by all three methods when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging after drying.

**5.12 CONDITION IN CONTAINER:** The mixed paint shall show no thickening, curdling, gelling, or hard caking when tested as specified in FED-STD-141, Method 3011, after storage for six months from date of delivery, in a full, tightly covered container, at a temperature of 50-100°F (10-43°C).

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coatings Association (NPCA) "Paint Industry Labeling Guide."

**6.2** Zinc dust, zinc-oxide pigment (Component A) for this paint shall be packaged separately to be mixed with the phenolic varnish vehicle (Component B) shortly before use. Each container of Component A or B shall be labeled to this effect together with directions showing the correct mixing ratios.

Provided by : www.spic.ir Licensee: NISOC Library

**6.3 MARKING OF CONTAINERS:** Each container of Component A or B shall be legible marked with the following information:

Name: Zinc Dust, Zinc Oxide, and Phenoic Varnish Paint
Specification: SSPC-Paint 5
Color: Metallic Zinc
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Component in Container:
Information and Warnings as may be required be Federal and state laws:
Manufacturer's Name and Address:

**6.4 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of Zinc Dust, Zinc Oxide, and Phenolic Varnish Paint

This paint is intended for use as a primer over pickled or blast cleaned steel in atmospheric exposure. It may also be used over clean galvanized steel. All rust scale, loose rust, loose mill scale, and loose or nonadherent paint shall be removed; oil and grease shall be removed to the fullest extent practical, as residues of oil and grease remaining on the surface will result in decreased paint performance.

Mix paint thoroughly before use. If less than the packaged amount of components A and B are to be mixed, use in the ratio 15 pounds (6.8 kg) of zinc dust-zinc oxide (Component A) to 5 pounds (2.3 kg) of phenolic varnish vehicle (Component B) to make one gallon of paint. Gradually add a small amount of the zinc dust-zinc oxide component to the base liquid while stirring continuously or intermittently, as the zinc dust-zinc oxide portion becomes thoroughly wetted with the liquid. Mixing may be made easier by transferring contents to a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

Wait until gassing has ceased before using paint. Do not store mixed paint in tightly sealed containers. During application of the paint, take special precautions to see that the zinc dust does not settle in the container.

Thin paint only if necessary, using only mineral spirits. For brush application under normal conditions, no thinning should be necessary. For spray applications, add up to one pint of thinner per gallon (130 ml/L) of paint when necessary.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 2 mils (50 micrometers) dry or approximately 3 mils (76 micrometers) wet. The surface to be painted shall be dry; the surface temperature shall be at least 5°F (3°C) above the dew point; and the temperature of the air shall be over 40°F (4°C). Do not paint outdoors in rainy weather or if freezing temperatures are expected before the paint dries.

This paint is fast drying and will dry hard in about 12 hours; special care must be exercised to prevent this paint from drying too hard before additional coats are applied; otherwise, special precautions must be taken to ensure adhesion of these coats. Recoating within 24 hours is recommended for maximum intercoat adhesion.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 8

## Aluminum Vinyl Paint

### 1. Scope

**1.1** This specification covers a ready-to-mix aluminum vinyl chloride, acetate copolymer paint intended for use over vinyl butyral wash primer (SSPC-Paint 27) or as a finish coat over vinyl chloride-acetate copolymer paint such as SSPC-Paint 9. This paint is not intended or recommended for use over bare steel.

**1.2** This paint is suitable for exposures in Environmental Zones 2C (fresh water immersion), 2D (salt water immersion), and 3B (chemical, neutral), and is intended primarily to be used as a finish coat in a system applied to blast cleaned (SSPC-SP 10) or pickled (SSPC-SP 8) steel. When used for salt water immersion, a wash primer is recommended. Because of the possibility of lifting of the undercoats, this paint is not intended to be used over types of paints which have poor solvent resistance. This paint is intended primarily for application by conventional air spray and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

### 2. Description

**2.1** This paint consists of metallic leafing aluminum pigment and vinyl resins in solution suitably plasticized to make a durable, elastic paint film. This paint includes a hydroxyl-containing polymer for good adhesion to wash primers. It is supplied, unless specified otherwise, as two components to be mixed just before use. Details of the composition are given in Table 1.

**2.2** This paint contains approximately 14% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 1.0 mil (25 micrometers) dry film thickness is 225 square feet/U.S. gallon (5.5 square

**TABLE 1**
**COMPOSITION**

| INGREDIENTS | REQUIRED Min. Wt. % | REQUIRED Max. Wt. % | TYPICAL COMPOSITION Wt.% | TYPICAL COMPOSITION Vol.% | INGREDIENT STANDARDS ASTM |
|---|---|---|---|---|---|
| PIGMENT: (10 ± 1 %) | | | | | |
| Aluminum Paste | 100.0 | — | 10.0 | 6.3 | D 962 Type 2 Class B |
| VEHICLE: (90 ± 1%) | | | | | |
| Vinyl Resin A[1] | 8.4 | — | 7.5 | 5.2 | — |
| Vinyl Resin B[2] | 8.4 | — | 7.5 | 5.1 | — |
| Dioctyl phthalate[3] | 1.6 | — | 1.6 | 1.2 | — |
| Methyl Isobutyl Ketone[4] | — | 40.8 | 36.7 | 42.6 | D 1153 |
| Toluene | — | 40.8 | 36.7 | 39.6 | D 362 |
| TOTALS | | 100.0 | 100.0 | | |

1 Vinyl Resin A shall be an hydroxyl containing vinyl chloride-acetate copolymer. It shall contain 89.5% to 91.5% vinyl chloride, 5.3% to 7.0% vinyl alcohol, and 2.0% to 5.5% vinyl acetate. The inherent viscosity of the resin (ASTM D 1243, Method A) at 20° C shall not be less than 0.5.

2 Vinyl Resin B shall be a carboxyl containing vinyl chloride-acetate copolymer. It shall contain 85% to 87% vinyl chloride, 12% to 14% vinyl acetate, and 0.5% to 1.0% maleic acid. The inherent viscosity of the resin (ASTM D 1243, Method A) at 20°C shall not be less than 0.48.

3 Dioctyl phthalate (di-2-ethylhexyl phthalate) shall be commercial material which conforms to the following requirements:

Specific gravity at 25°C 0.980—0.9861

Refractive index at 25°C 1.4830—1.6859

4 When specified in the procurement documents, suitable high boiling vinyl solvent may be substituted for a portion of the methyl isobutyl ketone to make the paint more amenable to application in hot weather or by brush.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**ANALYSIS**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | Max. Wt. % | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Pigment | 6.0 | 7.5 | D 1208 | 4021* |
| Volatiles | 75.0 | 78.5 | D 2369 | — |
| Nonvolatile vehicle calculated by difference | 15.5 | 17.5 | — | 4053 |
| Uncombined water | — | 0.5 | D 1208 | — |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 0.25 | D 185 | 4092 |

* Using extraction mixture “C” (1:1 toluene and acetone).

**TABLE 3**
**PROPERTIES**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Viscosity* sheer rate 200 rpm | | | | |
| Grams | 75 | 97 | D 562 | — |
| Kreb units | 54 | 60 | D 562 | — |
| Density lb/gal (g/L) | 7.5 (902) | 8.1 (974) | D 1475 | — |
| Drying time, minutes | | | | |
| Tack free | — | 15 | D 1640 | 4061 |
| Dry hard | — | 60 | D 1640 | 4061 |

*Viscosity 48 hours or more after manufacture.

meters/liter). Actual spreading rates can be significantly lower.

## 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

**PA 1** Shop, Field, and Maintenance Painting of Steel
**Paint 9** White (or Colored) Vinyl Paint
**Paint 27*** Basic Zinc Chromate – Vinyl Butyral Wash Primer
**SP 8** Pickling
**SP 10/NACE No. 2** Near-White Blast Cleaning

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

**D 185** Test Methods for Coarse Particles in Pigments, Pastes, and Paints
**D 362** (Canceled) Specification for Industrial Grade Toluene
**D 562** Test Method for Consistency of Paints Using the Stormer Viscometer
**D 962** Specification for Aluminum Powder and Paste Pigments for Paints
**D 1153** Specification for Methyl Isobutyl Ketone
**D 1208** Test Methods for Common Properties of Certain Pigments
**D 1243** Test Method for Dilute Solution Viscosity of Vinyl Chloride Polymers
**D 1296** Test Method for Odor of Volatile Solvents and Diluents
**D 1475** Test Method for Density of Paint, Varnish, Lacquer, and Related Products
**D 1640** Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **D 2369** | Test Method for Volatile Content of Coating |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL STANDARDS:**

| | |
|---|---|
| **DoD-P-15328** | Primer (Wash) Pretreatment |

**FED-STD-141,** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 3011** | Condition in Container |
| **Method 4021** | Pigment Content (Ordinary Centrifuge) |
| **Method 4053** | Nonvolatile Vehicle Content |
| **Method 4061** | Drying Time |
| **Method 4092** | Coarse Particles and Skins in Synthetic Vehicle Enamels, Lacquers and Dopes |
| **Method 4203** | Reducibility and Dilution Stability |
| **Method 4331** | Spraying Properties |
| **Method 4541** | Working Properties and Appearance of Dried Film |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals —Precautionary Labeling |

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1.

**4.2** The paint based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added. The aluminum paste shall be packaged separately unless otherwise specified in the procurement documents.

**4.3** The paint shall conform to the composition (analysis) requirements of Table 2.

## 5. Properties

**5.1** The paint shall meet the requirements of Table 3 and Sections 5.2 through 5.7.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**5.3 COLOR:** The vehicle before mixing with the aluminum paste shall be clear. The color after mixing shall be typical of aluminum paint (dull aluminum luster).

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when two volumes of the paint are slowly mixed with one volume of thinner consisting of 85% toluene and 15% methyl isobutyl ketone by volume (FED-STD-141, Method 4203).

**5.5 ADHESION:** The paint under test shall show good adhesion when tested as follows: apply one coat (1.0 mils, 25 micrometers dry film thickness) of the mixed paint to a clean steel panel free of rust or scale, also to a similar panel pretreated with wash primer DoD-P-15328, “Primer (Wash) Pretreatment,” or SSPC-Paint 27, “Basic Zinc Chromate—Vinyl Butyral Wash Primer” (0.5 mils, 12.5 micrometers dry film thickness). After a 24-hour dry, the film under test on each panel shall be subjected to a knife test to determine whether the paint exhibits good adhesion to the undercoats and to the steel.

**5.6 WORKING PROPERTIES:** The paint shall be easily applied when tested in accordance with FED-STD-141, Methods 4331 and 4541. The paint shall show no streaking, running, or sagging after drying.

**5.7 CONDITION IN CONTAINER:** The paint shall show no thickening, curdling, gelling, or hard caking when tested as specified in FED-STD-141, Method 3011, after storage for six months from date of delivery, in a full, tightly covered container, at a temperature of 50-110°F (10-43°C).

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling". Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.3 MARKING OF CONTAINERS:** Each container shall be legible marked with the following information:

Name: Aluminum Vinyl Paint
Specification: SSPC-Paint 8
Component:
Color: Aluminum
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required be Federal and State Laws:
Manufacturer's Name and Address:

Provided by : www.spic.ir Licensee: NISOC Library

**6.3 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of Aluminum Vinyl Paint

The paint is intended for use over vinyl butyral wash primer (SSPC-Paint 27) or as a finish coat over vinyl chloride-acetate copolymer paint. It is supplied in two components to be mixed just before using.

Gradually add small portions of the liquid to the aluminum paste. Mix the paste thoroughly until it is smooth and free of lumps. Then gradually add the reminder of the liquid, stirring constantly. It is recommended that the paint be mixed by a mechanical mixer.

The paint shall be thinned as necessary with solvent containing not more than 85% toluene and 15% methyl isobutyl ketone or methyl ethyl ketone. The amount of thinning will depend upon application methods and conditions, and may be as high as 25% to 33% by volume of the paint.

When required, this paint may be tinted to a contrasting color by the addition of a stable tinting pigment dispersed in a vinyl chloride-acetate copolymer resin solution.

Apply by conventional air spray. Brushing may be used in small areas. The surface to be painted shall be dry and above 35°F (2°C), not less than 5°F (3°C) above the dew point. Do not paint outdoors in rainy weather. Apply so as to obtain a minimum dry film thickness of 1.0 mils (25 micrometers). A wet film of paint shall be deposited on the surface when spraying; the spray gun should be adjusted so that proper atomization is obtained but no dry powder is deposited on the surface. The nozzle should be held about six inches from the surface during application.

If application is to be made by brush, apply with a brush heavily loaded with paint; apply quickly and smoothly. Avoid excessive brushing and do not go back over the surface until thoroughly dry.

At temperatures between 60 and 80°F (16 and 27°C), dry at least one hour between coats and 72 hours before immersion. Varying atmospheric conditions and degrees of ventilation in confined spaces may allow shorter or require longer drying times.

NOTE: This paint is not to be used as a priming coat next to bare steel.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 9

## White (or Colored) Vinyl Paint

### 1. Scope

**1.1** This specification covers a ready mixed white vinyl chloride-acetate copolymer paint intended for use as a primer over blast cleaned steel or over vinyl butyral wash primer (SSPC Paint 27*). It may also be used as an intermediate or finish coat over vinyl chloride-acetate copolymer paint.

**1.2** This paint is suitable for exposures in Environmental Zones 2C (fresh water immersion), 2D (salt water immersion), 3A (chemical, acidic), and 3B (chemical, neutral), and is intended primarily to be used in a system applied to blast cleaned (SSPC-SP 10) or pickled (SSPC-SP 8) steel. When used for salt water immersion, a wash primer is recommended. Because of the possibility of lifting of the undercoats, this paint is not intended to be used over types of paints which have poor solvent resistance. This paint is intended primarily for application by conventional air spray and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**1.3** This paint allows for a choice of colors.

### 2. Description

**2.1** This paint consists of titanium dioxide pigment and vinyl resins in solution suitably plasticized to make a durable, elastic paint film. This paint includes both a carboxyl-containing polymer for good adhesion to steel and a hydroxyl-containing polymer for good adhesion to wash primers. It is supplied, unless specified otherwise, as a white paint. Details of the composition are given in Table 1.

**2.2** This paint contains approximately 17% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 1.0 mil (25 micrometers) dry film thickness is 275 square feet/U.S. gallon (6.7 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **Guide 13** | Guide for the Identification and Use of Industrial Coating Material in Computerized Product Databases |
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **Paint 27*** | Basic Zinc Chromate — Vinyl Butyral Wash Primer |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 185** | Test Methods for Coarse Particles in Pigments, Pastes, and Paints |
| **D 362** | (Canceled) Specification for Industrial Grade Toluene |
| **D 476** | Specification for Titanium Dioxide Pigments |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 1153** | Specification for Methyl Isobutyl Ketone |
| **D 1208** | Test Methods for Common Properties of Certain Pigments |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1243** | Test Method for Dilute Solution Viscosity of Vinyl Chloride Polymers |
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1640** | Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL STANDARDS:**

| | |
|---|---|
| **DoD-P-15328*** | Primer (Wash) Pretreatment |

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 3011** | Condition in Container |
| **Method 4021** | Pigment Content (Ordinary Centrifuge) |
| **Method 4053** | Nonvolatile Vehicle Content |
| **Method 4061** | Drying Time |
| **Method 4092** | Coarse Particles and Skins in Synthetic Vehicle Enamels, Lacquers and Dopes |
| **Method 4203** | Reducibility and Dilution Stability |
| **Method 4331** | Spraying Properties |
| **Method 4541** | Working Properties and Appearance of Dried Film |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals — Precautionary Labeling |

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1.

**4.2** The paint based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added.

**TABLE 1**
**COMPOSITION**

| | REQUIRED | | TYPICAL COMPOSITION | | INGREDIENT STANDARDS |
|---|---|---|---|---|---|
| **INGREDIENTS** | **Min. Wt. %** | **Max. Wt. %** | **Wt.%** | **Vol.%** | **ASTM** |
| PIGMENT: (12 ± 1 %) | | | | | |
| Titanium Dioxide | 95.0 | — | 12.0 | 2.9 | D 476, Type II Class II |
| Tinting Pigments[1] | — | 5.0 | — | — | — |
| VEHICLE: (88 ± 1%) | | | | | |
| Vinyl Resin A[2] | 9.1 | — | 8.0 | 5.9 | — |
| Vinyl Resin B[3] | 9.1 | — | 8.0 | 5.9 | — |
| Dioctyl phthalate[4] | 3.4 | — | 3.0 | 2.5 | — |
| Methyl Isobutyl Ketone[5] | — | 39.2 | 34.5 | 43.0 | D 1153 |
| Toluene | — | 39.2 | 34.5 | 39.8 | D 362 |
| TOTALS | | | 100.0 | 100.0 | |

[1] Stable, durable tinting pigments shall be substituted for a portion of the pigment when a tint is specified in the procurement documents.

[2] Vinyl Resin A shall be an hydroxyl containing vinyl chloride-acetate copolymer. It shall contain 89.5% and 91.5% vinyl chloride, 5.3% to 7.0% vinyl alcohol, and 2.0% to 5.5% vinyl acetate. The inherent viscosity of the resin (ASTM D 1243, Method A) at 20°C shall not be less than 0.48.

[3] Vinyl Resin B shall be a carboxyl containing vinyl chloride-acetate copolymer. It shall contain 85% to 87% vinyl chloride, 12% to 14% vinyl acetate, and 0.5% to 1.0% maleic acid. The inherent viscosity of the resin (ASTM D 1243, Method A) at 20°C shall not be less than 0.48.

[4] Dioctyl phthalate (di-2-ethylhexyl phthalate) shall be commercial material which conforms to the following requirements:

Specific gravity @ 25°C 0.980 — 0.9861
Refractive index @ 25°C 1.4830 — 1.6859

[5] When specified in the procurement documents, suitable high boiling vinyl solvent may be substituted for a portion of the methyl isobutyl ketone to make the paint amenable to application in hot weather or by brush.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**ANALYSIS**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | Max. Wt. % | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Pigment | 11.0 | 13.0 | D 1208 | 4021† |
| Volatiles | 67.0 | 71.0 | D 2369 | — |
| Nonvolatile vehicle calculated by difference | 18.0 | 20.0 | — | 4053 |
| Uncombined water | — | 0.5 | D 1208 | — |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 0.25 | D 185 | 4092 |

†Using extraction mixture "C" (1:1 toluene and acetone)

**TABLE 3**
**PROPERTIES**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Viscosity† sheer rate 200 rpm | | | | |
| Grams | 100 | 150 | D 562 | — |
| Krebs | 61 | 72 | D 562 | — |
| Weight per U.S. gallon, pounds | 8.1 (974 g/l) | 8.7 (1074 g/l) | D 1475 | — |
| Fineness of grind, Hegman units | 6.0 | — | D 1210 | — |
| Drying time, minutes | | | | |
| Tack free | — | 15 | D 1640 | 4061 |
| Dry hard | — | 30 | D 1640 | 4061 |

†Viscosity 48 hours or more after manufacture.

**4.3** The paint shall conform to the composition (analysis) requirements of Table 2.

## 5. Properties

**5.1** The paint shall meet the requirements of Table 3 and Sections 5.2 through 5.7.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**5.3 COLOR:** The color shall be white unless otherwise specified in the procurement documents.

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when two volumes of the paint are slowly mixed with one volume of thinner consisting of 85% toluene and 15% methyl isobutyl ketone by volume (FED-STD-141, Method 4203).

**5.5 ADHESION:** The paint under test shall show good adhesion when tested as follows: apply one coat (1.0 mils, 25 micrometers dry film thickness) of the mixed paint to a clean steel panel free of rust or scale, and also to a similar panel pretreated with wash primer DoD-P-15328, "Primer (Wash) Pretreatment," or SSPC-Paint 27, "Basic Zinc Chromate—Vinyl Butyral Wash Primer" (0.5 mils, 12.5 micrometers dry film thickness). After a 24-hour dry, the film under test on each panel shall be subjected to a knife test to determine whether the paint exhibits good adhesion to the undercoats and to the steel.

**5.6 WORKING PROPERTIES:** The paint shall be easily applied when tested in accordance with FED-STD-141, Methods 4331 and 4541. The paint shall show no streaking, running, or sagging after drying.

**5.7 CONDITION IN CONTAINER:** The paint shall show no thickening, curdling, gelling, or hard caking when tested as specified in FED-STD-141, Method 3011, after storage for six months from date of delivery, in a full, tightly covered container, at a temperature of 50-110°F (10-43°C).

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemi-

Provided by : www.spic.ir Licensee: NISOC Library

cals—Precautionary Labeling". Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.3 MARKING OF CONTAINERS:** Each container shall be legible marked with the following information:

Name: White (or Colored) Vinyl Paint
Specification: SSPC-Paint 9
Color: White (if tinted, state color)
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required be Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of White (or Colored) Vinyl Paint

This paint is intended for use as a primer over blast cleaned steel or over vinyl butyral wash primer (SSPC-Paint 27.) It may also be used as an intermediate or finish coat over vinyl chloride-acetate copolymer paint. Mix thoroughly before use.

The paint shall be thinned as necessary with solvent containing not more than 85% toluene and 15% methyl isobutyl ketone or methyl ethyl ketone. The amount of thinning will depend upon application methods and conditions, and may be as high as 25% to 33% by volume of paint.

When required, this paint may be tinted to a contrasting color by the addition of a stable tinting pigment dispersed in a vinyl chloride-acetate copolymer resin solution.

Apply by conventional air spray. Brushing may be used in small areas. The surface to be painted shall be dry and above 35°F (2°C), not less than 5°F (3°C) above the dew point. Do not paint outdoors in rainy weather. Apply so as to obtain a minimum dry film thickness of 1.0 mils (25 micrometers).

A wet film of paint shall be deposited on the surface when spraying; the spray gun should be adjusted so that proper atomization is obtained such that dry paint (similar to overspray) is not deposited on the surface. The nozzle should be held about six inches from the surface during application.

If application is to be made by brush, apply with a brush heavily loaded with paint; apply quickly and smoothly. Avoid excessive brushing and do not go back over the surface until thoroughly dry.

At temperatures between 60 and 80°F (16 and 27°C), dry at least one hour between coats and 72 hours before immersion. Varying atmospheric conditions and degrees of ventilation in confined spaces may allow shorter or require longer drying times.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

*This paint contains chromate pigments. Users are urged to follow all health, safety, and environmental requirements in applying, handling, and disposing of these materials.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 11

## Red Iron Oxide, Zinc Chromate, Raw Linseed Oil and Alkyd Primer*

### 1. Scope

**1.1** This specification covers a slow drying red iron oxide, zinc chromate, raw linseed oil and alkyd primer for steel. It has excellent rust inhibitive characteristics, good wetting ability, about 24 hours drying time, and good resistance to weathering for normal periods before field coating.

**1.2** This primer is suitable for exposures in Environmental Zones 1A (interior, normally dry) and 1B (exterior, normally dry), and is intended for brush or spray application over steel surfaces prepared in accordance with SSPC-SP 2, "Hand Tool Cleaning." The performance will be improved by a better degree of surface preparation. It is suitable as a shop primer, field primer, maintenance primer, or intermediate coat and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel." If the primed part of the structure is to be exposed to the weather, it should be topcoated as soon as practical.

### 2. Description

**2.1** The good wetting ability of this primer is the result of its high proportion of raw linseed oil. Details of the composition are given in Table 1.

**2.2** This primer contains approximately 70% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 2.0 mil (51 micrometers) dry film thickness is 560 square feet/U.S. gallon (13.8 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **SP 2** | Hand Tool Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS**:

| | |
|---|---|
| **D 185** | Test Methods for Coarse Particles in Pigments, Pastes, and Paints |
| **D 234** | Specification for Raw Linseed Oil |
| **D 235** | Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent) |
| **D 478** | Specification for Zinc Yellow (Zinc Chromate) Pigments |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 600** | Specification for Liquid Paint Driers |
| **D 605** | Specification for Magnesium Silicate Pigment (Talc) |
| **D 1208** | Test Methods for Common Properties of Certain Pigments |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1542** | Test Method for Qualitative Detection of Rosin in Varnishes |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 2371** | Test Method for Pigment Content of Solvent-Reducible Paints |
| **D 3278** | Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus |
| **D 3722** | Specification for Natural Red and Brown Iron Oxide Pigments |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL STANDARDS:**

| | |
|---|---|
| **TT-R-266** | Resin, Alkyd: Solutions |

Provided by : www.spic.ir Licensee: NISOC Library

**FED-STD-141:** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 3011** | Condition in Container |
| **Method 3021** | Skinning (Partially Filled Container) |
| **Method 4021** | Pigment Content (Ordinary Centrifuge) |
| **Method 4053** | Nonvolatile Vehicle Content |
| **Method 4061** | Drying Time |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals—Precautionary Labeling |

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1.

**4.2** The primer based on the specified ingredient shall be uniform, stable in storage, and free from grit and coarse particles. No rosin or rosin derivatives may be used. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added.

**4.3** The paint shall conform to the composition (analysis) requirements of Table 2.

## 5. Properties

**5.1** The paint shall meet the requirements of Table 3 and Sections 5.2 through 5.7.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**5.3 COLOR:** The color shall be typical of the specified mixture of zinc yellow and red iron oxide.

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when two volumes of the paint are slowly mixed with one volume of mineral spirits (FED-STD-141, Method 4023).

**5.5 WORKING PROPERTIES:** The paint shall be easily applied by all three methods when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging after drying.

**5.6 CONDITION IN CONTAINER:** The paint shall show no thickening, curdling, gelling, or hard caking when tested as specified in FED-STD-141, Method 3011, after storage for six months from date of delivery, in a full, tightly covered container, at a temperature of 50-110°F (10-43°C).

**TABLE 1**
**COMPOSITION**

| | REQUIRED | | TYPICAL COMPOSITION | | INGREDIENT STANDARDS | |
|---|---|---|---|---|---|---|
| **INGREDIENTS** | **Min. Wt. %** | **Max. Wt. %** | **Wt.%** | **Vol.%** | **ASTM** | **Federal** |
| PIGMENT: (50 ± 2 wt. %) | | | | | | |
| Red Iron Oxide (85% $Fe_2O_3$) | 40 | — | 20.0 | 6.8 | D 3722* | — |
| Magnesium Silicate | — | 20 | 10.0 | 5.5 | D 605 | — |
| Zinc Chromate | 40 | — | 20.0 | 8.5 | D 478 Type I | — |
| VEHICLE: (50 ± 2 wt. %) | | | | | | |
| Raw Linseed Oil | 33 | — | 16.5 | 27.0 | D 234 | — |
| Alkyd Resin Solids | 33 | — | 16.5 | 23.5 | — | TT-R-266, Type II |
| Mineral Spirit Thinner | — | 34 | 17.0 | 17.0 | D 235 | — |
| Driers | — | — | — | — | D 600 Class B | — |
| TOTALS | | | 100.0 | 100.0 | | |

* The Red Iron Oxide (Natural) shall also comply with the following:

| | |
|---|---|
| Water Solubles | 0.3% Max. |
| Coarse Particles on 325 Mesh Sieve | 0.1% Max. |
| Moisture and Other Volatile Matter | 0.2% Max. |
| Organic Matter | None |

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**ANALYSIS**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | Max. Wt. % | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Pigment | 48 | 52 | D 2371 | 4021 |
| Volatiles | — | 20 | D 2369 | — |
| Nonvolatile vehicle calculated by difference | 31 | — | — | 4053 |
| Uncombined water | — | 1.0 | D 1208 | — |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 1.5 | D 185 | — |
| Rosin or rosin derivatives | — | 0 | D 185 | — |

**TABLE 3**
**PROPERTIES**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Viscosity* shear rate 200 rpm | | | | |
| Grams | 150 | 250 | D 562 | — |
| Krebs | 72 | 89 | D 562 | — |
| Weight per U.S. gallon, pounds | 11.5 | — | D 1475 | — |
| Fineness of grind, Hegman units | 3.0 | — | D 1210 | — |
| Drying time, hours | | | | |
| Tack free | — | 10 | — | 4061 |
| Dry hard | — | 24 | — | 4061 |
| Flash point, degrees F | 100 | — | D 3278 | — |
| Sag Resistance, mils | 6 | — | — | 4494 |

*Viscosity 48 hours or more after manufacture.

**5.7 SKINNING:** There shall be no skinning in a three-quarters filled closed container after 48 hours when tested in the standard manner specified in FED-STD-141, Method 3021.

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legibly marked with the following information:

Name: Red Iron Oxide, Zinc Chromate, Raw Linseed Oil and Alkyd Primer
Specification: SSPC-Paint 11
Color: Red Iron Oxide
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of Red Iron Oxide, Zinc Chromate, Raw Linseed Oil and Alkyd Primer

This paint is intended for use as a primer over hand cleaned steel in atmospheric exposure; it will perform better if the steel is power tool cleaned, blast cleaned, or pickled. All rust scale, loose rust, loose mill scale, and loose or nonadherent paint shall be removed; oil and grease shall be removed to the fullest extent practical, as residues of oil and grease remaining on the surface will result in decreased

Provided by : www.spic.ir Licensee: NISOC Library

paint performance.

Mix paint thoroughly before use. If the pigment has settled, pour off most of the liquid. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring contents to a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

Thin paint only if necessary, using only mineral spirits. For brush application under normal conditions, no thinning should be necessary. For spray applications, add up to one pint of thinner per gallon (130 ml/L) of paint when necessary.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 2 mils (50 micrometers) dry or approximately 3 mils (76 micrometers) wet. The surface to be painted shall be dry; the surface temperature shall be at least 5°F (3°C ) above the dew point; and the temperature of the air shall be over 40°F (4°C). Do not paint outdoors in rainy weather or if freezing temperatures are expected before the paint dries.

Allow paint at least 24 hours drying time in good weather before recoating.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Note

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

*This paint contains chromate pigments. Users are urged to follow all health, safety, and environmental requirements in applying, handling, and disposing of these materials.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 12

## Cold-Applied Asphalt Mastic (Extra Thick Film)

### 1. Scope

**1.1** This specification covers a cold-applied asphalt mastic coating for structural steel. It has no rust inhibiting characteristics and affords protection by excluding corrosive media to a high degree. It acts as a vapor seal because of its relative impermeability, which is attained by application in thick coats.

**1.2** This mastic is suitable for exposures in Environmental Zones 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 3B (chemical, neutral), and 3C (chemical, alkaline); and is intended for spray application over steel surfaces prepared in accordance with SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." It is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel." A rust inhibitive priming coat or pretreatment is recommended in highly corrosive environments.

### 2. Description

**2.1** Cold-applied asphalt mastic contains asphalt and petroleum solvents, either naturally occurring or petroleum derived or both. Details of the composition are given in Table 1.

**2.2** This mastic contains approximately 50% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 63 mil (1,600 micrometers) dry film thickness is 12.7 square feet/U.S. gallon (0.3 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **Paint 27*** | Basic Zinc Chromate – Vinyl Butyral Wash Primer |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **B 117** | Practice for Operating Salt Spray (Fog) Apparatus |
| **D 5** | Test Method for Penetration of Bituminous Materials |
| **D 235** | Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent) |

**TABLE 1**
**COMPOSITION**

| INGREDIENTS | REQUIRED Min. Wt. % | REQUIRED Max. Wt. % | INGREDIENT STANDARDS ASTM | INGREDIENT STANDARDS Federal |
|---|---|---|---|---|
| FILLER: (40 wt. % max.) | | | | |
| Inorganic Filler Contains Short Fiber Asbestos and Free Inert Material | — | 100 | — | — |
| VEHICLE: (60 wt. min.) | | | | |
| Asphalts | 45 | 65 | — | — |
| Mineral Spirit Thinner | 35 | 55 | D 235 | TT-T-291, Type I |



Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 1856** | Test Method for Recovery of Asphalt from Solution by Abson Method |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 2939** | Test Methods for Testing Emulsified Bitumens Used as Protective Coatings |
| **D 3278** | Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus |

**3.6 FEDERAL STANDARDS AND SPECIFICATIONS:**

| | |
|---|---|
| **A-A-2904** | Thinner, Paint, Mineral Spirits, Regular and Odorless |
| **A-A-59295** | Corrosion Preventive Compounds Cold Application (for New and Fielded Motor Vehicles and Trailers) |
| **TT-C-520**** | (canceled) Coating compound, Bituminous, Solvent Type, Underbody (for Motor Vehicles) (Refer to A-A-59295) |
| **TT-T-291** | (canceled) Thinner, Paint, Mineral Spirits, Regular and Odor less (Refer to A-A-2904) |

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 3011** | Condition in Container |
| **Method 3021** | Skinning (Partially Filled Container) |
| **Method 4021** | Pigment Content (Ordinary Centrifuge) |
| **Method 4053** | Nonvolatile Vehicle Content |
| **Method 4203** | Reducibility and Dilution Stability |
| **Method 4311** | (canceled) Volume Percentage of Pigment in Total Nonvolatile Matter (Calculation Method) |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals — Precautionary Labeling |

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1 and in Sections 4.2 through 4.6.

**4.2 ASPHALTS:** Bitumens shall consist of asphalts, either naturally occurring or petroleum derived, and may include up to 50% by weight of gilsonite; any petroleum asphalt used shall be a straight run, steam or vacuum refined residue and shall be air blown in accordance with good commercial practice.

**4.3 FILLERS:** Fillers used shall be suitable inorganic minerals and short fiber asbestos. Sand and other harsh abrasive materials shall not be used. The fillers (exclusive of asbestos) shall be fine enough to pass through a 325 mesh screen. Not more than 15% by weight of the total mastic shall be retained on a 325 mesh screen as determined by washing the mastic through the screen with suitable solvent.

**4.4 PETROLEUM SOLVENTS:** The volatile solvents shall consist of any suitable aliphatic petroleum solvents with a minimum flash point of 90°F (32°C).

**4.5** The mastic based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. No water, coal, tar, or coal tar solvents may be added.

**4.6** The paint shall conform to the composition (analysis) requirements of Table 2.

## 5. Properties

**5.1** The paint shall meet the requirements of Table 3, Sections 5.2 through 5.18.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**5.3 COLOR:** The color shall be black.

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the mastic when two volumes of the mastic are slowly mixed with one volume of mineral spirits (FED-STD-141, Method 4203).

**5.5 WORKING PROPERTIES:** The mastic shall be capable of application by brush and trowel in addition to spraying with standard high pressure spray equipment of the types recommended for the application of mastics. The consistency shall be such that it may be sprayed at a temperature of 50°F (10°C) with a tank pressure of not more than 80 psi (550 kPa) gage and no more than 80 psi (550 kPa) gage air pressure on the gun nozzle. A coating thus applied shall be uniform, continuous, and free from any pinholing.

**5.6 CONDITION IN CONTAINER:** The mastic shall show no thickening, curdling, gelling, or hard caking when tested as specified in FED-STD-141, Method 3011, after storage for six months from date of delivery, in a full, tightly

Provided by : www.spic.ir Licensee: NISOC Library

covered container, at a temperature of 50-100°F (10-43°C).

**5.7 SKINNING:** There shall be no skinning in a three-quarters filled closed container after 48 hours when tested in the standard manner specified in FED-STD-141, Method 3021.

**5.8 SAG TEST:** A 1/8-inch (3 mm) wet film coating of the mastic shall not sag when suspended vertically for one hour immediately after spraying, and there shall be no flowing and piling up of the coating on the lower half of the panel.

**5.9 DRYING TIME:** A wet film of coating, sufficient to deposit a 63 mil (1,600 micrometers) thick dry film shall set to touch in four hours and shall reach practical hardness in 36 hours at a test temperature of 70-75°F (21-24°C) and 45%-55% relative humidity. The coating is considered to have reached practical hardness when firm pressure between the thumb and fingers shows a slight tacky condition, but the film is not ruptured and none of the coating adheres to the finger.

**5.10 HARDNESS:** The dry, cured mastic shall have a penetration of not more than 1.0 mm at 77°F (25°C), 2.0 mm at 95°F (35°C), 7.5 mm at 150°F (66°C), or 15 mm at 180°F (82°C) when tested according to ASTM D 5 using a 50 gram weight.

**5.11 ACID AND ALKALI RESISTANCE:** Spray a coating of the mastic on both sides of degreased 4" x 12" (10 x 30 cm) cold rolled steel panels to give a dry film thickness of approximately 63 mils (1,600 micrometers). After the coating has dried for 24 hours, bake ten days at 125°F (52°C) and allow to cool at room temperature. Seal the panels around the edges with a high melting point wax by dipping each edge approximately 1/4 inch (66 mm) in a molten solution of the wax and then immerse in test solutions of acids and alkalis to a depth of six inches (15 cm) for 30 days at 75°F (24°C) or ten days at 125°F (52°C). On removal the panel shall be rinsed in tap water, wiped dry with a soft rag, and observed for any marked change in appearance. The coating shall then be removed by solvent cleaning and the panel surface examined for evidence of pitting and rusting. The panel shall show no sign of attack after immersion for 30 days in 10% solutions of hydrochloric acid, sulfuric acid, and sodium hydroxide. On removal of the coating by solvent cleaning, the panel surface shall be free from any pitting or rusting.

**5.12 CORROSIVITY:** Precleaned, polished strips of copper, aluminium, and steel of any convenient size, but not less than 1/2" x 3" (12 mm x 76 mm), shall be completely immersed in a bath of the mastic at a temperature of 170-180°F (77-82°C) for 24 hours. The strips shall then be removed, rinsed with a petroleum naphtha solvent, and dried. The strips shall be examined for evidence of staining or corrosion. The steel strips shall show no trace of corrosion. Copper and aluminum strips shall show no more staining and corrosion than similarly prepared strips heated for 24 hours in an oven 170-180°F (77-82°C), but not immersed in the compound.

**5.13 FIRE RESISTANCE:** Spray and condition a coating of the compound on three steel panels 3" x 6" (7.6 cm x 15 cm) as in Section 5.11. Suspend one of the test panels vertically in a shielded hood. A laboratory burner with the air supply shut off and the flame regulated to 2" (5 cm) length shall be placed under the panel so that the lower end of the panel is in the flame one inch (2.5 cm). The flame shall be allowed to remain under the test panel for 20 seconds. After the flame is withdrawn, the time that the flaming continues shall be observed. This test shall be run in triplicate and the results averaged. The dry coating may char, but shall not support combustion for more than ten seconds when the flame source is removed.

**5.14 RESISTANCE TO FLOW AT ELEVATED TEMPERATURE:** Spray and condition a coating of the compound as in Section 5.11. Parallel lines spaced 1/2"(1 cm) apart shall be drawn across the width of the surface. The panel shall then be suspended in a vertical position in an oven at 320-330°F (160-166°C) for 24 hours. On removal, observe the surface of the coating for shifting of the lines. There shall be no evidence of flow or creep.

**5.15 SALT SPRAY RESISTANCE:** Prepare three steel panels as in Section 5.11, then expose 450 hours to a salt spray fog as prescribed in ASTM B 117, "Salt Spray (Fog) Testing." On removal from the salt fog cabinet observe the surface for evidence of rusting and pinholing. The coating shall be tested for lifting by inserting a spatula under the coating along one of the waxed edges and noting whether it lifts easily from the panels or adheres firmly. Lifting of the coating as a solid film or in an area of four square inches (100 square cm) or more shall be cause for rejection. The coating shall then be removed by solvent cleaning and the panel surface observed for pitting and rusting. The coating shall show no signs of blistering or excessive lifting; upon removal of the coatings, the steel surface shall be free of pitting or rusting.

**5.16 COLD-TEMPERATURE ADHESION:** A 63 mil (1,600 micrometers) dry-film coating of the mastic shall be prepared and tested as specified in Federal Specification TT-C-520** "Coating Compound, Bituminous, Solvent Type, Underbody (for Motor Vehicles);" it shall be subjected to successive slams at angles of 70, 80, and 90 degrees in the slamming machine specified. Any loosening, flaking, or chipping off shall not exceed 5% of the total area at -10°F (-23°C).

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**ANALYSIS**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Filler (wt. %) | — | 40 | D 1856 | 4021* |
| Volatiles (wt. %) | — | 38 | D 2369 | — |
| Nonvolatile bituments calculated by difference (wt. %) | 27 | — | — | 4053 |
| Pigment % by volume of nonvolatile | — | 25 | — | 4311 |

* Use benzene and extract at least five times.

**TABLE 3**
**PROPERTIES**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM |
|---|---|---|---|
| Weight per U.S. gallon, pounds | 8.0 | 9.5 | D 2939 |
| Flash Point of solvents, degrees F | 90 | — | D 3278 |

**5.17 ABRASION RESISTANCE:** Spray and condition a coating of the mastic as in Section 5.11 and lay the panel flat in a sandblasting cabinet. The coating shall then be subjected to 20 passes of the blast from a suction type sandblast gun conforming to the following dimensions: diameter of air orifice—7/32"(6 mm); diameter of nozzle—112" (12 mm); inside diameter of sand hose—1-1 /4"(3 cm); length of sand hose—10"(3 m); air pressure at nozzle—92-100 pounds per square inch gage; type of sand—Ottawa Silica Sand; mesh of sand—20-45. The sandblast gun shall traverse the 4"(10 cm) width of the panel in not less than two seconds at a distance of one inch (2.5 cm) from the surface of the coating. After 20 passes with the sandblast gun, the blasted area shall be examined for evidence of film failure. The coating shall not be cut through to bare metal at any point.

**5.18 WATER VAPOR TRANSMISSION:** The water vapor permeability of a 63 mil (1,600 micrometers) thick dry coating of the mastic prepared on a porous base and cured as in Section 5.11, shall not be over 0.0015 ounces per square foot per 24 hours under a vapor pressure differential of 11.8 mm of mercury at 77°F (25°C). The test shall be made with standard permeability glass cups each containing 40 cc of water, and covered with a sample of the dry coating. The units are sealed with wax and placed in a room or container held at 50% relative humidity and 77°F (25°C). At different intervals of time, the cells are weighed separately. The weight loss is taken as the amount of water vapor (weight per 24 hours per area) lost by diffusion through the coating after equilibrium in water vapor transmission has been established.

## 6. LABELING

**6.1** Refer to ANSI Standard Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legibly marked with the following information:

Name: Cold-Applied Asphalt Mastic
Specification: SSPC-Paint 12
Color: Black
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions use shall be supplied with each container of paint:

Directions for Use of Cold-Applied Asphalt Mastic

This mastic is used to protect steel from corrosion in severe surroundings. It will perform best if applied over blast cleaned or pickled steel; however, it may be used over well cleaned steel if all rust scale, loose rust, loose mill scale, and loose or nonadherent paint are removed. Oil and grease should be removed. For severe exposure, apply

Provided by : www.spic.ir Licensee: NISOC Library

over a thoroughly dry rust-inhibitive primer.

Mix paint thoroughly before use. Under normal conditions, no thinning should be necessary. Thin paint only if necessary, using only mineral spirits.

Apply by spray, using high pressure spray equipment. If applied by brush, apply with a daubing action.

Apply to the specified film thickness or, if none is specified, to at least 63 mils (1,600 micrometers) dry or approximately 126 mils (3,200 micrometers) wet. The surface to be painted shall be dry; the surface temperature shall be at least 5°F (3°C ) above the dew point; and the temperature of the air shall be over 40°F (4°C). Do not paint outdoors in rainy weather or if freezing temperatures are expected before the paint dries. Under normal conditions, this mastic will dry for recoating in 243 hours, but it will remain soft for long periods.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance w1ith all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

*This paint includes chromate pigments. Users are urged to follow all health, safety and environmental requirements in applying, handling, and disposing of these materials.

**TT-C-520 has been canceled and replaced by MIL-C-2218, "Corrosion Preventive Compounds, Cold Application (for New and Fielded Motor Vehicles and Trailers)," which was also canceled. Refer to A-A-59295.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 15
May 1, 1999
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 15

## Steel Joist Shop Primer

### 1. Scope

**1.1** This specification covers a one coat shop primer for open web and long span steel joist and joist girders and for cold formed steel framing. This coating is intended to provide temporary protection to the steel joist during delivery, storage on site, and erection in an atmosphere comparable with SSPC Environmental Zone 1, normally dry. This coating is intended to be used as a holding primer that may or may not be removed before or after erection or assembly in the field.

**1.2** The specification does not address the formulation of the coating but covers the physical and performance characteristics of the coating.

### 2. Description

**2.1 COMPOSITION:**

**2.1.1** Wide latitude is given for the composition of the coating. The formulation will be agreed upon between the contracting parties, so that the coating is compatible with the owner's facility and processes, while meeting or exceeding the performance requirements of this specification.

**2.1.2** This specification will cover all generic classes of coatings.

**2.2 VOLATILE ORGANIC COMPOUND (VOC) REQUIREMENTS:**

**2.2.1** The VOC content of a merchantable coating meeting the compositional and performance requirements of this specification can vary from less than 60 g/L to over 420 g/L.

**2.2.2** The specifier should consult applicable government regulations to determine the maximum allowable VOC content and the proper VOC test method for their application. As a part of the purchase documents, the specifier should state the required VOC limit, test method, and governing regulations. (See Note 11.1.)

### 3. Reference Standards

**3.1** The documents and standards referenced in this specification are listed in Sections 3.3 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 2** | Measurement of Dry Coating Thickness with Magnetic Gauges |
| **SP 1** | Solvent Cleaning |
| **SP 2** | Hand Tool Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **VIS 1-89** | Visual Standard for Abrasive Blast Cleaned Steel |
| **VIS 2** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **A 36** | Specification for Carbon Structural Steel |
| **B 117** | Practice for Operating Salt Spray (Fog) Apparatus |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 714** | Test Method for Evaluating Degree of Blistering of Paints |
| **D 1200** | Test Method for Viscosity by Ford Viscosity Cup |
| **D 1308** | Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes |
| **D 1475** | Test Method for Density of Paint, Vanish, Lacquer, and Related Products |
| **D 1654** | Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments |
| **D 2243** | Test for Freeze-Thaw Resistance of Water-Borne Coatings |
| **D 3359** | Test Methods for Measuring Adhesion by Tape Test |
| **D 3363** | Test Method for Film Hardness by Pencil Test |
| **D 3924** | Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |
| **D 3960** | Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings |

Provided by : www.spic.ir Licensee: NISOC Library

**D 4062** Test Method for Leveling of Paints by Draw-Down Method

**D 4585** Practice for Testing Water Resistance of Coatings Using Controlled Condensation

**D 5894** Practice for Cyclic Corrosion/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and UV/Condensation Cabinet)

**3.6 NATIONAL PAINT AND COATINGS ASSOCIATION (NPCA) STANDARD:**

Paint Industry Labeling Guide

**3.7 BAY AREA AIR QUALITY MANAGEMENT DISTRICT (BAAQMD)**

**METHOD 41** Determination of Volatile Organic Compounds in Solvent Based Coatings and Related Materials Containing Parachlorobenzotrifluoride

## 4. Standard Testing Conditions

**4.1** When testing the paint and its application, the conditions under which it is applied and cured shall conform to ASTM D 3924.

**4.2** The hot rolled steel test panels shall conform to ASTM A 36 or equivalent. Prior to preparing the surface, the amount of rust and mill scale on the surface shall conform to Rust Grade A or Rust Grade B as described in SSPC-VIS 1-89. Panel size shall be 100 mm x 150 mm x 4.8 mm (4 in x 6 in x 3/16 in) or greater.

**4.3** Surface preparation shall consist of SSPC-SP 1 and SSPC-SP 2.

**4.4** The dry film thickness of the primer shall be as recommended by the manufacturer. If no recommendation is given, the dry film thickness shall be a minimum of 20 micrometers (0.8 mils) unless indicated otherwise. Measure dry film thickness in accordance with SSPC-PA 2.

**4.5** All coated panels to be tested will be allowed to cure for a minimum of seven days under ambient laboratory conditions before physical testing is to begin.

## 5. Physical Properties

**5.1 TEST INFORMATION:** The paint manufacturer shall measure and record batch testing information that will allow certification that a batch meets the necessary standards established by the manufacturer for the primer as tested per Section 5.

**5.2 CONDITION IN CONTAINER:** Each component as received shall show no evidence of livering, skinning, or hard settling of the pigment. The inside of the container shall not be corroded. Multi-component material shall be easily dispersed in the liquid portion by hand stirring to form a smooth, homogeneous primer.

**5.3 COLOR:** There is no color requirement; however, color will be agreed upon between the contracting parties or be the color of the sample submitted under Section 9.2.

**5.4 VISCOSITY:** The viscosity of the stirred primer shall be determined in accordance with ASTM D 562. Variance of viscosity measured in KU shall be within 12 percent of the viscosity of the previously qualified coating and the value published by the manufacturer (e.g., technical data sheet or container label).

For viscosities lower than 55 KU, a number 4 Ford Cup shall be used in accordance with ASTM D 1200. Variations shall be within five seconds of the previously qualified coating. The contracting parties may agree to different variances.

**5.5 DENSITY:** Density of the mixed primer shall be determined in accordance with ASTM D 1475. Variance shall be within ± 48 g/L (0.4 lb/gal) of the sample submitted under Section 9.2.

**5.6 FREEZE-THAW RESISTANCE (WATER-BORNE COATINGS ONLY):** The liquid (water base) coating shall be tested in accordance with ASTM D 2243. At the end of three cycles there shall be no gelling or excessive thickening, coagulation, lumps, or coarse particles. The maximum increase or decrease in viscosity shall not exceed 10 Krebs units.

## 6. Performance Testing Requirements

**6.1 RUST AND BLISTER RESISTANCE:**

**6.1.1 Test Panel Preparation:** Apply one coat of the steel joist shop primer to the front of nine steel panels in accordance with the standard testing conditions specified in Section 4. Coat and seal all edges and the back side of each panel with a coating or masking that will provide the necessary protection to these surfaces.

Scribe a 5 cm (2 inch) vertical line through the lower middle portion of the primed panels so as to expose the underlying metal before testing. The conditions of making the scribe are described in ASTM D 1654.

**6.1.2 Salt Spray:** Three replicate panels shall be exposed in a salt spray conducted in accordance with ASTM B 117. The duration of the test shall be 96 hours. The rust rating of each replicate panel shall be 8 or higher according to SSPC-VIS 2. (See Note 11.2.) The blister rating of each panel shall be no worse than No. 4 "Few," No. 6 "Medium," or No. 8 "Medium Dense" using ASTM D 714. (See Note 11.3.) The maximum undercutting or rusting measured from the center of the scribe of each replicate

Provided by : www.spic.ir Licensee: NISOC Library

panel shall not exceed 3.2 mm (1/8 inch) at any point along the scribe. (See Note. 11.4.)

**6.1.3 Cyclic Salt Fog/UV Exposure:** Three replicate panels shall be exposed in a cyclic corrosion test conducted in accordance with ASTM D 5894. The duration of the test shall be 336 hours that represent one week of UV/condensation followed by one week of cyclic salt fog. The rust rating of each replicate panel shall be 8 or higher according to SSPC-VIS 2. (See Note 11.2.) The blister rating of each panel shall be no worse than No. 4 "Few," No. 6 "Medium," or No. 8 "Medium Dense" using ASTM D 714. (See Note 11.3.) The maximum undercutting or rusting measured from the center of the scribe of each replicate panel shall not exceed 3.2 mm (1/8 inch) at any point along the scribe.

**6.1.4 Condensation:** Three replicate panels shall be exposed in a condensing cabinet according to ASTM D 4585 for a duration of 96 hours. The rust rating of each replicate panel shall be 8 or higher according to SSPC-VIS 2. (See Note 11.2.) The blister rating of each panel shall be no worse than No. 6 "Few" or No. 8 "Medium" using ASTM D 714. (See Note 11.3.) The maximum undercutting or rusting measured from the center of the scribe of each replicate panel shall not exceed 3.2 mm (1/8 inch) at any point along the scribe.

**6.2 ADHESION:** Apply one coat of the steel joist shop primer to the front of a steel panel in accordance with the standard testing conditions specified in Sections 4.1 through 4.4. After seven days, apply a second coat under similar conditions. Allow the second coat to cure for a minimum of seven days under ambient laboratory conditions before physical testing is to begin. Evaluate adhesion to the base metal as well as between coats using ASTM D 3359, Method B "Cross-Cut Tape Test," spacing the cuts 1 mm apart. A minimum rating of 4B is required. (See Note 11.5.)

**6.3 WATER SENSITIVITY:** Apply one coat of the steel joist shop primer by the drawdown method (ASTM D 4062) to a 100 mm x 200 mm (4 x 8 in) cold-rolled steel panel in accordance with Sections 4.1 and 4.4. Allow to dry at 21 to 25°C (70 to 77°F) and 50% ±5% relative humidity. After 24 hours drying time, subject the coating to a water spot test for four hours in accordance with ASTM D 1308, using the open spot test and 2 to 3 ml of potable water. No blistering shall occur. The film may soften, but film integrity shall return after a 24 hour recovery period. Film integrity is defined as losing no more than one pencil hardness unit (ASTM D 3363) compared to the unexposed film.

**6.4 FLASH RUST RESISTANCE TEST (WATER-BORNE COATINGS ONLY):** Coat a hot rolled steel panel blast cleaned to SSPC-SP 6 or better in accordance with Sections 4.1, 4.2, and 4.4. Allow to dry for 24 hours. The coatings shall show no signs of flash rusting or bleeding.

## 7. Application

**7.1** Coatings can be formulated for dip, flow coat, vacuum coat, airless, air atomized, brushed, or rolled application.

## 8. Labeling

**8.1** Refer to the National Paint and Coatings Association (NPCA) "Paint Industry Labeling Guide" for labeling guidelines and procedures.

**8.2 MARKING OF CONTAINERS:** Each container of each component shall be legibly marked with the following information:

Name: Steel Joist Shop Primer
Specification: SSPC-Paint 15
Manufacturer's Name and Address:
Product Number:
Generic Type of Coating:
Color:
Lot or Batch Number:
Date of Manufacturer (not necessary if contained in lot or batch number):
Quantity of coating in container(s):
Information and Warnings as may be Required by Federal and State Laws:
Shelf Life Between Temperature Range: Do not freeze (if a waterborne primer)
VOC Content:
Mixing Ratios and Procedures:

**8.3 PRODUCT TECHNICAL DATA:** Technical data shall be provided on a separate sheet containing, but not limited to the following information:

Product Name:
Generic Type of Coating:
Surface Preparation:
Mixing Ratios and Procedures:
Application Procedure:
Recoatability:
Theoretical Volume Solids:
Theoretical Weight Solids:
VOC Content:
Safety Data:
Information and Warnings as may be required by Federal and State Laws:
Shelf Life Between Temperature Range:
Storage Information:

## 9. Inspection

**9.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or

Provided by : www.spic.ir Licensee: NISOC Library

his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 11.6.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**9.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**9.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 10. Disclaimer

**10.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**10.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 11. Notes

Notes are not requirements of this specification.

**11.1** ASTM D 3960 is a commonly used method to determine VOC, but this method may not be acceptable to all jurisdictions. The method of determining VOC content described in ASTM D 3960 does not address analysis of VOC exempt solvents such as PCBTF (parachlorobenzotriflouride). Methods published by government agencies include Bay Area Air Quality Management District (BAAQMD) Method 41 and California Air Resources Board (CARB) Method 310.

**11.2** A rust grade rating of 8 or better implies that no more than 0.1% of the surface area shall be rusted.

**11.3** According to ASTM D 714, ratings that would be considered better than No. 4 "Few," No. 6 "Medium," and No. 8 "Medium Dense" would include No. 6 "Few," No. 8 "Medium," No. 8 "Few," and No. 10 (no blisters). Interpolated ratings not pictured in ASTM D 714 that would be considered better than No. 4 "Few," No. 6 "Medium," and No. 8 "Medium Dense" would include No. 5 "Few," No. 7 "Medium," No. 7 "Few," No. 9 "Medium Dense," No. 9 "Medium," and No. 9 "Few." In general, a higher number (smaller size) blister is considered better that a lower number blister of the same frequency. Similarly, for a given size, fewer blisters are better.

**11.4** The salt fog test, ASTM B 117, has been widely discredited as a method for evaluating paints. There have been many comparative paint studies using widely different formulations which showed no correlation and even negative correlation between salt fog results and atmospheric exposure results. There is a significant risk that a good coating can be rejected based on salt fog performance. Cyclic salt fog/UV exposure, ASTM D 5894, has been shown to have much better correlation with atmospheric exposures.

**11.5** The adhesion test described in Section 6.2 is to prevent coating manufacturers from adding wax or other additives that would severely limit the adhesion of a subsequent coating layer.

**11.6** The procurement documents should establish the responsibility for samples, testing, documentation of performance tests and results and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 16
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 16

## Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint

### 1. Scope

**1.1** This specification covers a two-component coal tar epoxy-polyamide black (or dark red) paint for structural steel. It is self-priming and exhibits good adhesion to clean structural steel and concrete surfaces.

**1.2** This paint is suitable for exposures in Environmental Zones 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 2C (fresh water immersion), 2D (salt water immersion), 3A (chemical, acidic), 3B (chemical, neutral), and 3C (chemical, alkaline); and is intended for spray application over steel surfaces prepared in accordance with SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." It is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel." The adhesion of the coating to smooth surfaces such as cold-rolled steel or intact mill scale has been found to be substantially inferior to that attained on blast roughened surfaces.

### 2. Description

**2.1** The coal tar epoxy-polyamide black (or dark red) paint consists of two parts. Component A contains a refined coal tar pitch, a liquid-type polyamide resin, and a polyamine promoter to accelerate curing rate. Component B is a liquid-type epoxy resin which is mixed into Component A just prior to application. Details of the composition are given in Table 1.

**2.2** This paint contains approximately 71% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 8 mil (200 micrometers) dry film thickness is 142 square feet/U.S. gallon (3.5 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness with Magnetic Gages |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **SP 6/NACE No.3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 4** | Test Method for Bitumen Content |
| **D 5** | Test Method for Penetration of Bituminous Materials |
| **D 20** | Test Method for Distillation of Road Tars |
| **D 36** | Test Method for Softening Point of Bitumen (Ring and Ball Apparatus) |
| **D 139** | Method for Float Test for Bituminous Materials |
| **D 364** | (canceled) Specification for Industrial Grade Xylene |
| **D 605** | Specification for Magnesium Silicate Pigment (Talc) |
| **D 609** | Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products |
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1544** | Test Method for Color of Transparent Liquids (Gardner Color Scale) |
| **D 1652** | Test Methods for Epoxy Content of Epoxy Resins |
| **D 2415** | Test Method for Ash in Coal Tar and Pitch |
| **D 3721** | Specification for Synthetic Red Iron Oxide Pigment |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**COMPOSITION**

| INGREDIENTS | REQUIRED Min. Wt. % | REQUIRED Max. Wt. % | TYPICAL COMPOSITION Component A & B Wt.% | TYPICAL COMPOSITION Component A & B Vol.% | INGREDIENT STANDARDS |
|---|---|---|---|---|---|
| COMPONENT A (82 ± 0.5 Wt. %) (80 Vol. %) | | | | | |
| Coal Tar Pitch | 33.0 | 36.0 | 28.2 | 29.0 | Paragraphs 4.3 and 5.1 |
| Polyamide Resin | 11.0 | 12.0 | 9.5 | 12.4 | Paragraphs 4.5 and 5.3 |
| Magnesium Silicate[1] | 30.0 | 33.0 | 25.8 | 11.9 | ASTM D 605 |
| Xylene[2] | 18.0 | 21.0 | 15.4 | 22.9 | ASTM D 364 |
| Gelling Agent and Activator | 2.5 | 2.6 | 2.0 | 2.4 | Paragraph 4.6 |
| Accelerator | 1.2 | 1.3 | 1.1 | 1.4 | Paragraph 4.7 |
| Component A Totals | 100 | | 82.0 | 80.0 | |
| COMPONENT B (18 ± 0.5 Wt. %) (20 Vol. %) | | | | | |
| Liquid Epoxy Resin | --- | --- | 18.0 | 20.0 | Paragraphs 4.2 and 5.2 |
| TOTALS (Component A&B) | 100 | 100 | 100.0 | 100.0 | |

[1] When specified in the procurement documents, a dark red colored coating shall be furnished in which 50% or more (by volume) of the magnesium silicate is replaced by synthetic red iron oxide conforming to ASTM D 3821. The red coating shall meet all of the test requirements prescribed for the black coating, except that the nonvolatile content of Component A shall be an amount reflecting the greater specific gravity of the iron oxide pigment.
[2] In most cases where the specified volatiles are not permitted, the volatile portion of the coal tar epoxy coating may be replaced with exempt materials to the extent necessary to assure compliance with the applicable regulations. The modified coating shall meet all of the test requirements specified herein except that determination of compliance with the nonvolatile weight content shall reflect any difference in specific gravity between xylene and the substituted solvents.

**3.6 FEDERAL STANDARDS:**

**MIL-PRF-23236** Paint Coating Systems, Fuel and Salt Water Ballast Tanks (Metric)

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

**Method 2161** Application of Film with Film Applicator (Magnetic Chuck)

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

**Z129.1** Hazardous Industrial Chemicals—Precautionary Labeling

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1 and in Sections 4.3 through 4.7.

**4.2** Each component of this paint based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles.

**4.3** Coal tar pitch used in this coating is defined as a product obtained from the distillation of high temperature crude coke oven tar, which in itself is a product obtained during the destructive distillation of coal in slot ovens operated at a temperature above 1,292°F (700°C). The coal tar pitch shall be composed primarily of a complex combination of three or more membered condensed ring aromatic hydrocarbons.

**4.4** The epoxy resin shall be a di-epoxide condensation product of bisphenol-A and epichlorohydrin with terminal epoxide groups.

**4.5** The polyamide resin shall be a condensation product of a dimerized fatty acid in polyamines.

**4.6** Acceptable gelling agents are organic derivatives of magnesium montmorillonite and hydrogenated castor oil. Ac-

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**ANALYSIS OF COAL TAR PITCH**

| Characteristics | Type 1 Min. | Type 1 Max. | Type 2 Min. | Type 2 Max. | Type 3 Min. | Type 3 Max. | ASTM |
|---|---|---|---|---|---|---|---|
| Float Test at 50°C, Seconds | — | — | — | — | 150 | 220 | D 139 |
| Softening Point, in water, °C | 70 | 75 | 54 | 62 | — | — | D 36 |
| Insolubles in Carbon Disulfide, % by weight | — | 20 | — | 20 | — | 20 | D 4 |
| Ash, % by weight | — | 0.5 | — | 0.5 | — | 0.5 | D 2415 |
| Distillation, Dry Basis, % by weight | | | | | | | |
| 0-170°C | — | — | — | — | — | 0 | — |
| 0-250°C | — | 0 | — | 0 | — | — | — |
| 0-270°C | — | — | — | — | — | 6 | — |
| 0-300°C | — | 5 | — | 5 | — | 15 | — |
| Softening Point of Residue at 300°C, in water, °C | — | — | — | — | 45 | 60 | D 36 |

**TABLE 3**
**ANALYSIS EPOXY RESIN**

| CHARACTERISTICS | REQUIREMENTS Min. | REQUIREMENTS Max. | ASTM |
|---|---|---|---|
| Epoxide Equivalent | 180 | 200 | D 1652 |
| Nonvolatile content (1-2 grams after 1 hour @ 105 ± 2°C), % by weight | 99 | — | — |
| Color, Gardner | — | 5 | D 1544 |
| Specific Gravity | 1.15 | 1.18 | D 1475 |
| Viscosity, Brookfield, at 25°C, poises | 100 | 160 | — |

ceptable activators, if used, are methanol, ethanol, or propylene carbonate.

**4.7** The accelerator shall be 2,4,6-tri (dimethylamino methyl) phenol.

## 5. Properties

**5.1** The coal tar pitch used shall meet the requirements for one of the types listed in Table 2.

**5.2** The epoxy resin shall be clear, free of turbidity, crystals, and particulate matter and shall meet the requirements of Table 3.

**5.3** The polyamide resin shall be clear, free of turbidity and particulate matter and shall meet the requirements of Table 4.

**5.4** Component A of this paint shall meet the requirements of Sections 5.5 through 5.8.

**5.5 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**5.6 COLOR:** The color shall be black or dark red.

**5.7** The viscosity of Component A shall not exceed 160 poises when tested as follows.

Fill a container having a diameter and a height of not less than 3" (7.6 cm) and 3-3/4" (9.5 cm), respectively, to a depth of not less than 3" (7.6 cm) with a representative sample of Component A. Set up a Model RVT or RVF-100 Brookfield Synchro-Electric Viscometer with a No. 7 spindle and with guard removed. Bring the sample to (and thereafter maintain) a temperature of 25°C (77°F) and stir vigorously for two minutes with a stiff spatula. Immediately after stirring, lower the viscometer until 1/2 of the "neck" mark on the spindle is covered. Run the viscometer at 100 rpm for one minute and take a reading of the position of the pointer on the dial. If the dial reading is 40 or less, the viscosity shall be considered to be 160 poises or less. If the reading is over 40, immediately start the motor and take additional readings at one-minute intervals. If one or more readings of 40 or less are obtained out of ten readings, taken at one-

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 4**
**ANALYSIS OF POLYAMIDE RESIN**

| CHARACTERISTICS | REQUIREMENTS Min. | REQUIREMENTS Max. | ASTM METHOD |
|---|---|---|---|
| Amine Value* | 330 | 360 | --- |
| Nonvolatile content (1-2 grams after 1 hour @ 105±2°C), % by weight | 97 | --- | --- |
| Color, Gardner | --- | 9 | D 1544 |
| Specific Gravity | 0.96 | 0.98 | D 1475 |
| Viscosity, Brookfield, at 75°C, poises | 7 | 9 | --- |

* The amine value is defined as the milligrams of potassium hydroxide equivalent to the amine alkalinity present in a one-gram sample. It is determined by a potentiometric titration with standard perchloric acid according to the following method:

A. Weigh the approximate amount of well mixed resin to give a titration in the range of 12 to 18 ml into a tared 200 ml berzelius tall form beaker on an analytical balance. Cover the beaker with aluminum foil to minimize contact with air.
B. From a graduated cylinder, carefully add 90 ml of solvent (suitable solvents are nitrobenzene, propylene carbonate, or acetonitrile), insert a stirring bar, cover the beaker with aluminum foil, and stir on a magnetic stirrer to dissolve the sample. Add the solvent immediately after weighing the sample. A fume hood should be used for all operations.
C. From a graduated cylinder, add 20 ml of glacial acetic acid to the sample solution and stir for several minutes.
D. Immerse the electrodes into the sample solution, stir for two minutes, and titrate potentiometrically with 0.1 N perchloric acid using the millivolt scale. Record the millivolt readings every 0.1 ml. Plot a graph showing the millivolts against the titration. The endpoint is the midpoint of the inflection on the titration curve.
E. Conduct a blank determination on 90 ml of the solvent and 20 ml of acetic acid. The blank need only be determined once for each lot of solvent used. On the majority of the lots used, the blank has been found to be zero.
F. Calculate the amine value using the following formula:

$$\text{Amine Value} = \frac{(\text{Sample Titration} - \text{Solvent Blank}) \times \text{Normality} \times 56.1}{\text{Weight of Sample}}$$

minute intervals, the viscosity of the material shall be considered to be within specification limits.

**5.8** The nonvolatile content of Component A shall not be less than 77% (by weight) when tested as follows.

Place a stirrer made of stiff wire into a small disposable aluminum dish of about 2" (5 cm) in diameter and weigh to the nearest 0.1 mg. As rapidly as possible, place between two and three grams of Component A into the dish and weigh immediately to the nearest 0.1 mg. After weighing, spread the material over the bottom of the dish. Heat the dish, wire, and contents in a well ventilated convection-type oven maintained at 103-107°C for three hours. After the material has been in the oven for a few minutes, and periodically thereafter, stir the material. Cool in a desiccator, weigh to the nearest 0.1 mg, and calculate the percentage of nonvolatile on a weight basis.

**5.9 PHYSICAL REQUIREMENTS OF THE MIXED COATING:** The mixed paint shall meet the requirements of Sections 5.10 through 5.15.

**5.10 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**5.11 COLOR:** The color shall be black or dark red.

**5.12 SAG:** The coating shall not sag when tested as follows.

Prepare approximately 500 ml of the material by thoroughly mixing 100 ml of Component B into 400 ml of Component A. Determine its viscosity immediately after mixing, using the same procedure outlined in Section 5.7, but employing a No. 5 spindle. If all of five readings taken at one-minute intervals are above 50, reduce the viscosity by adding the thinner in small increments until a reading of not greater than 50 is obtained. Press a strip of 1" (2.5 cm) masking tape across the full width of a solvent-cleaned 3" x 6" (7.6 cm x 15.2 cm) cold-rolled steel panel. The tape shall be parallel to and centered on the shorter axis of the panel. Within five minutes after making the final check of viscosity, apply the material to the panel at a wet film thickness of at least 14 mils (350 micrometers). The application may be made with a doctor blade having a gap of approximately 25 mils (635 micrometers) or by brush. Immediately after applying the material, carefully remove the masking tape and stand the panel in a vertical position (with the bare strip horizontal) in a draft-free, 75-80°F (24-27°C) location. Examine the panel after four hours. Sagging

Provided by : www.spic.ir Licensee: NISOC Library

or running of the coating into the base area shall constitute failure of the material to pass the sag test. Save the mixed coating for the penetration and adhesion tests described in Sections 5.13 and 5.14, respectively.

**5.13 PENETRATION:** The coating shall pass the following test.

Select and solvent spray clean two 3" x 6" (7.6 cm x 15.2 cm) cold-rolled steel panels in accordance with ASTM D 609. Draw down in accordance with FED-STD-141, Method 2161 a coat of the coating mixed (including any thinning) for the sag test. Allow the film to dry 18 to 24 hours in a horizontal position at 75 to 80°F (24 to 27°C) and at a relative humidity of not over 60%. Apply a second coat over and at right angles to the first, using freshly mixed coating prepared identically to that used for the first coat. (Save both coatings for preparing adhesion test panels.) The drawdown applicator shall be such as to provide a total dry film thickness of 20 to 25 mils (508 to 635 micrometers), and the coats shall be of approximately equal thickness. Allow the second coat to dry in a horizontal position at 75 to 80°F (24 to 27°C). After 120 hours of curing, clamp the panel onto the table of the penetrometer (ASTM D 5) so that the needle is over an area which is within the prescribed thickness range (as measured by SSPC-PA 2, "Measurement of Dry Paint Thickness with Magnetic Gages"), and determine the penetration, using a total load of 200 grams applied for five seconds at 77°F (25°C). The average of the three lowest out of five penetration readings, all taken within a one centimeter square, shall not exceed 0.03 cm after 120 hours of curing.

**5.14 ADHESION:** The coating shall pass the following test.

Sand blast two steel panels (similar to those used in the penetration test) with a clean, 30 to 50 mesh nonmetallic abrasive until a uniform, gray-white surface, with well-developed anchor pattern, is achieved. Blow off dust with a clean air blast. Brush apply one coat each of the two test batches of paint used for the penetration test panels, allowing the first coat to dry 18 to 24 hours at 74 to 80°F (24 to 27°C) before applying the second. Each coat shall be applied at a wet film thickness of 10 to 14 mils (250 to 350 micrometers). After the final coat has cured for 120 hours at 74 to 80°F (24 to 27°C), test the adhesion of the coating to the metal with a sharp knife. It shall strongly resist being removed from the metal. Also test the intercoat adhesion by attempting to separate the coats with the knife. Any delamination of the two coats shall constitute failure.

**5.15 POT LIFE:** The coating shall pass the following: Mix 100 ml of Component B into 400 ml of Component A, both of which have been brought to a temperature of 75 to 80°F (24 to 27°C) before mixing. Pour the material at once into a pint tin can, seal tightly, and store at 75 to 80°F (24 to 27°C). Examine the material four hours after it was mixed. For its pot life to be considered satisfactory, the mixed material shall remain in a fluid condition, and, when thinned with no more than 100 ml of xylene (or where required, the recommended thinner), shall be lump-free and brushable.

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2** Four gallons of Component A shall be packaged in a standard five-gallon container with a lug type removable lid. Component B shall be packaged to the full mark in a one-gallon can with friction lid. Other forms of packaging which provide the required ratio (4:1/A:B by volume) of components are permissible unless otherwise specified in the procurement documents.

**6.3 MARKING OF CONTAINERS:** Each container of each component shall be legibly marked with the following information:

Name: Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint
Specification: SSPC-Paint 16
Component:
Color: Black (or Dark Red)
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.4 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint

This paint is intended for use both as a primer and finish coat(s) over steel which has been blast cleaned or blast cleaned and primed with a suitable inhibitive primer. It may be used on steel in chemical or marine environments, on buried tanks and pipes, on steel immersed in fresh or salt water, in tidal, splash, and weather zone exposures, and for interiors of tanks and lines containing crude oil, salt brine, or caustic soda.

To prepare the paint for application, add the entire contents of the epoxy resin (Component B) container to the previously stirred contents of the related container of base (Component A) and mix vigorously for at least two minutes with a power agitator equipped with a 3" (7.6 cm) or longer

Provided by : www.spic.ir Licensee: NISOC Library

blade. Some thinning may be desirable for spray application. Use xylene or, where required, the recommended thinner and not more than one-half gallon (1.9 L) to a five-gallon (18.9 L) batch should be added. Apply the paint as soon after mixing as practicable since the material will thicken substantially over a two-hour period and may set up in the paint tank within two to four hours during very warm weather unless cooled prior to or after mixing.

This coating is usually applied by spray in two coats to a dry film thickness of 16 mils (406 micrometers) at its thinnest spots. This requires a spreading rate of 60 square feet per gallon (1.5 square meters per liter) of unthinned paint. In actual practice, upwards of 12 mils (305 micrometers) wet paint will probably be required for each 8 mil (203 micrometers) coat to obtain the desired minimum thickness. The drying time between coats under normal coating conditions shall not exceed 72 hours. Long drying times between coats may cause poor intercoat adhesion, and it is advisable in warm weather to reduce the maximum interval between coats. Under conditions of hot weather or direct sunlight, it may be necessary to limit the intercoat drying period to 24 hours or less.

Abusive handling of precoated steel may cause damage to the coating. This is more noticeable at low temperatures or after extended periods of cure.

This paint may be applied to large surfaces by high-pressure airless spray. For application to complex surfaces, use heavy-duty conventional air atomization spray equipment. If the application is by brush, apply with a stiff brush heavily loaded with paint; apply quickly and smoothly, and avoid excessive brushing.

Do not apply this coating when the receiving surfaces or the ambient temperatures are below 50°F (10°C), unless it can reasonably be anticipated that the average ambient temperature will be 50°F (10°C) or higher for the five-day period subsequent to the application of any coat. At temperatures between 50 and 60°F (10 and 15°C), allow the mixed paint to stand at least 30 minutes prior to application.

Clean all equipment immediately after use with a suitable solvent. Such cleaning solvents as high-flash aromatic naphtha, xylene, or toluene are satisfactory for clean-up, but can be improved by adding 10 to 20% of methyl isobutyl ketone and 10% isopropyl or normal butyl alcohol.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**9.2** Coal tar epoxy-polyamide coatings exhibit excellent adhesion to other primers such as vinyl butyral wash primers, some types of zinc-filled primers, and freshly-applied conventional (without coal tar pitch) epoxy resin primers. Adhesion of this coating to aged epoxy resin primers of any type is questionable. This coating, when used as a self-primed system, has a proved performance record. When used in severe exposures, a suitable inhibitive primer may prolong the life of the system.

**9.3** If the system is applied in two coats, the drying time of the first coat should be held to a minimum. Application of the second and subsequent coats may be applied as soon as practicable providing their application will not cause sagging of the total film. Under some climatic conditions excessive film thickness per coat (40-66 mils, 1,000-1,700 micrometers) can result in solvent entrapment and film cracking.

Provided by : www.spic.ir Licensee: NISOC Library

**9.4** Airless spraying equipment capable of developing upwards of 2,000 psi (13.8 MPa) hydraulic pressure is satisfactory for applying this paint to simple flat or near flat surfaces and to medium to large diameter pipes. Conventional air spray should be employed to coat complex surfaces.

**9.5** The temperature of the two components of this paint at the time of mixing has a large effect on its pot life. They should be stored under ventilated cover during hot weather and protected from the direct sun before and after mixing insofar as practicable. In some cases, it may be desirable to have Component A packaged in white containers in order to assist in the control of heat buildup. During cool weather, provisions should be made to maintain the temperature of the mixed paint at above 60°F (15°C), and preferably above 70°F (20°C), if satisfactory atomization is to be obtained without excessive thinning.

**9.6** Inasmuch as the coating does not lend itself to precise color matching or to the attainment of other than dark, dull shades of brownish-red, the purchaser should be careful not to specify a precise color which is impractical to produce.

**9.7** With respect to the manufacture of the base component, it is suggested that the following points be kept in mind. 1) Anti-sag characteristics of the mixed paint are largely determined by the degree of dispersion of the gelling agent. Where an organic derivative of magnesium montmorillonite type gelling agent is used, dampening with the activator prior to milling is believed to be helpful in obtaining a greater degree of anti-sag efficiency. 2) The use of a low oil absorption type of filler may facilitate the attainment of a balance of properties such that viscosity and anti-sag requirements will be met. 3) In order to provide some margin of processing freedom, the minimum nonvolatile content and the range in composition have been established at levels which permit an appreciable variation in the amount of solvent used in making up the base component. Also, the amount of gelling agent and activator to be used is specified only on an approximate basis. 4) The polyamide resin as currently manufactured can vary in imidazaline content which has an effect on the manufacturing and performance properties of the coating. Use of the polyamide resin meeting the requirements of this specification will reduce problems in these cases.

**9.8** Federal Specification MIL-PRF-23236, covers a coal tar epoxy paint whose curing component is not limited to any specific type. The specification is primarily of the performance type which requires that the materials meet certain Quality Assurance Provisions, including one based upon an 18 months' service test. The specification is intended primarily to provide coatings which are suitable for ship tanks used for fuel and salt water ballast, but there is little doubt that coal tar epoxy coatings meeting the specified requirements are of high quality and well suited for the broader applications commonly associated with paints of this type. However, the Federal Specification does not contain provisions which assure that the paint will necessarily have application, intercoat adhesion, low odor, strength, rapid curing rate, and properties comparable to those required by the instant specification.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 17

## Chlorinated Rubber Inhibitive Primer

### 1. Scope

**1.1** This specification covers a fast drying chlorinated rubber inhibitive primer for use on steel surfaces or exterior non-submerged surfaces, as well as most submerged surfaces prior to being overcoated with additional chlorinated rubber coatings. When applied as a shop coat to steel expected to be exposed to normal weathering or mild chemical environments for more than 60 days, it is recommended that either an additional coat of primer be applied or that the next succeeding coat be applied in the shop. This coating is not recommended for areas exposed to strong organic solvents, oxidizing acids, or to areas where the surface temperature exceeds 165°F (74°C). Straight chain unsaturated acids, and fats and oils of animal or vegetable origin will cause softening and swelling of the coating.

**1.2** This primer, when applied over properly prepared steel surfaces and coated with SSPC-Paint 18, "Chlorinated Rubber Intermediate Coat Paint," and followed by at least one (optional) finish coat of SSPC-Paint 19, "Chlorinated Rubber Topcoat Paint," is suitable for exposures in Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 2C (fresh water immersion), 2D (salt water immersion), 3A (chemical, acid), 3B (chemical, neutral), and 3C (chemical, alkaline).

**1.3** Steel surfaces shall be blast cleaned in accordance with SSPC-SP 6, "Commercial Blast Cleaning," for atmospheric use or with SSPC-SP 10, "Near-White Blast Cleaning," for immersion or heavy chemical use. Steel may also be prepared according to SSPC-SP 8, "Pickling."

**1.4** This primer is intended for application by brush, roller, or spray and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**1.5** If this coating is applied over alkyd- or oil-base enamels, there is the possibility of lifting, particularly on interior surfaces. A spot check is necessary to determine suitability. If lifting occurs, then a seal-coat, as recommended by the manufacturer, may be required. For immersion service, this coating should not be applied over alkyd or oil-base enamels.

### 2. Description

**2.1** This primer is a mixture of inhibitive pigments, extender pigments, chlorinated rubber, chlorinated resins, plasticizers, and solvents. Details of the composition are given in Table 1.

**2.2** This primer contains a minimum of 32% by volume of nonvolatile film-forming solids (pigment and binder). The minimum theoretical spreading rate for a 1.5 mil (38 micrometers) dry film thickness is 340 square feet/U.S. gallon (8.4 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **Paint 18** | Chlorinated Rubber Intermediate Coat Paint |
| **Paint 19** | Chlorinated Rubber Topcoat Paint |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **B 117** | Method of Salt Spray (Fog) Testing |
| **D 13** | Specification for Spirits of Turpentine |
| **D 185** | Test Methods for Coarse Particles in Pigments, Pastes, and Paints |

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**COMPOSITION**

| INGREDIENTS | REQUIRED Min. Wt. % | REQUIRED Max. Wt. % | TYPICAL COMPOSITION Wt.% | TYPICAL COMPOSITION Vol.% | INGREDIENT STANDARDS ASTM | INGREDIENT STANDARDS Federal |
|---|---|---|---|---|---|---|
| PIGMENT: (39 ± 10 wt. %) | | | | | | |
| Rust Inhibitive Pigments[1] | 35.0 | — | 26.3 | 5.3 | — | — |
| Tinting Pigments[2] | — | 12.0 | 0.3 | 0.2 | — | — |
| Extender Pigments | — | 55.0 | 12.1 | 6.4 | — | — |
| Barytes | | | | | D 602 | — |
| Magnesium | | | | | D 605 | — |
| Mica | | | | | D 607 | — |
| VEHICLE: (61 ± 10 wt. %) | | | | | | |
| Chlorinated Rubber[3] | 19.0 | — | 12.3 | 10.8 | — | — |
| Chlorinated Resins | — | — | 3.3 | 3.0 | — | MIL-C-429, Type II |
| Chlorinated Plasticizers | 10.0 | 18.0 | 6.7 | 8.4 | — | MIL-C-429 Type I |
| Plasticizer[4] | — | — | — | — | — | — |
| Solvents[5] | — | 65.0 | 37.0 | 64.0 | — | — |
| Vehicle Stabilizers[6] | 0.6 | — | 0.4 | 0.5 | — | — |
| Vapor Phase Stabilizers[7] | 0.2 | — | 0.1 | 0.2 | — | — |
| Suspending Aids[8] | — | 3.0 | 1.5 | 1.2 | — | — |
| TOTALS | | | 100.0 | 100.0 | | |

1 The rust inhibitive pigments shall be of good quality and such that when incorporated in the vehicle portion of this specification paint, the proposed paint will perform equal to or better than the paint made from the "control formulation" at each inspection period in the tests described in Sections 5.8 through 5.12. NOTE: When this paint is to be used in a paint system applied to the interior of potable water vessels, the ingredients shall not be deemed objectionable for such use by the U.S. Environmental Protection Agency or any agency that would have jurisdiction over such matters. When so formulated, the Salt Fog Test (Section 5.9) requirement shall be waived.

2 Lightfast and compatible chemically resistant colored pigments shall be used to provide a tint or color when desired.

3 The chlorinated rubber shall contain approximately 66% by weight chlorine. The viscosity (based on a solution of 20% by weight concentration in toluene at 20°C) shall fall in the range of 9 to 14 centipoise, when measured according to ASTM D 445. Up to 50% by weight of the amount of chlorinated rubber could be of the viscosity range of 17 to 25 centipoises, but spray application is more difficult.

4 Alternative plasticizers can be used, provided they are compatible, high quality, and chemically resistant.

5 The solvent shall consist of aromatic or a blend of aromatic and aliphatic hydrocarbons, with the aliphatic portion limited to 25% by weight, and shall have a minimum kauri butanol value of 75. Up to 10% by weight of turpentine (ASTM D 13) or other highboiling aromatic type solvents may be added to improve application properties.

6 The vehicle stabilizer shall be a suitable chloride accepter such as an expoxidized vegetable oil.

7 A vapor phase stabilizer, such as propylene oxide, can also be used. It must be a high-grade commercial material suitable for the intended purpose.

8 The suspending aid shall be hydrogenated castor oil or montmorillonite mineral.

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **D 445** | Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity) |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 602** | Specification for Barium Sulfate Pigments |
| **D 605** | Specification for Magnesium Silicate Pigment (Talc) |
| **D 607** | Specification for Wet Ground Mica Pigments |
| **D 1208** | Test Methods for Common Properties of Certain Pigments |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1542** | Test Method for Qualitative Detection of Rosin in Varnishes |
| **D 3278** | Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |
| **D 3728** | Specification for 2-Ethoxyethyl Acetate (99% Grade) |

**3.6 FEDERAL STANDARDS:**

**MIL-C-429** Chlorinated Paraffin, Technical

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 2011** | Preparation of Steel Panels |
| **Method 3011** | Condition in Container |
| **Method 4021** | Pigment Content (Ordinary Centrifuge) |
| **Method 4053** | Nonvolatile Vehicle Content |
| **Method 4061** | Drying Time |
| **Method 4203** | Reducibility and Dilution Stability |
| **Method 4321** | Brushing Properties |
| **Method 4331** | Spraying Properties |
| **Method 4541** | Working Properties and Appearance of Dried Film |
| **Method 6221** | Flexibility |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

**Z129.1** Hazardous Industrial Chemicals—Precautionary Labeling

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1.

**4.2** The primer based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. No rosin or rosin derivatives may be used. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added.

**4.3** The paint shall conform to the composition (analysis) requirements of Table 2.

## 5. Properties

**5.1** The paint shall meet the requirements of Table 3 and Sections 5.2 through 5.6.

**5.2 ODOR**: Shall be normal for the materials permitted (ASTM D 1296).

**TABLE 2**
**ANALYSIS**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | Max. Wt. % | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Pigment | 29.0 | 49.0 | D 1208 | 4021 |
| Volatiles | — | 46.0 | D 1208 | — |
| Nonvolatile vehicle | 15.0 | — | — | 4053 |
| Uncombined water | — | 0.25 | D 1208 | |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 0.05 | D 185 | — |
| Rosin or rosin derivaties | — | 0 | D 1542 | — |

* Viscosity 48 hours or more after manufacture.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 3**
**PROPERTIES**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Viscosity* shear rate 200 rpm | | | | |
| Kreb units | 70 | 90 | D 562 | — |
| Weight per U.S. gallon, pounds | 11.5 (1.4 kg/L) | 14.0 (1.7 kg/L) | D 1475 | — |
| Fineness of grind, Hegman units | 3.0 | — | D 1210 | — |
| Drying time: | | | | |
| Set to Touch, minutes | 15 | — | — | 4061 |
| Dry hard, hours | 1 | — | — | 4061 |
| Flash Point, degrees F | 80 (27°C) | — | D 3278 | — |

*Viscosity 48 hours or more after manufacture.

**TABLE 4**
**COMPOSITION OF CONTROL PAINT**

| INGREDIENTS | TYPICAL COMPOSITION Wt.% | Vol.% | INGREDIENT STANDARDS ASTM | Federal |
|---|---|---|---|---|
| Basic Lead Silico Chromate[2] | 30.0 | 11.5 | D 1648 | — |
| Barytes | 13.0 | 4.7 | D 602 | — |
| Chlorinated Rubber[1] | 12.5 | 11.6 | — | — |
| Chlorinated Resins | 7.4 | 7.2 | — | MIL-C-429, Type II |
| Chlorinated Plasticizers | 4.1 | 5.5 | — | MIL-C-429, Type I |
| Modified Hydrogenated Castor Oil | 1.5 | 2.7 | — | — |
| Epoxidized Soya Oil | 0.9 | 1.2 | — | — |
| Propylene Oxide | 0.1 | 0.2 | — | — |
| Xylene | 23.7 | 44.1 | D 3728 | — |
| Ethylene Glycol Monoethyl Ether Acetate | 6.8 | 11.3 | D 343 | — |
| TOTALS | 100.0 | 100.0 | | |

[1] The chlorinated rubber shall contain approximately 66% by weight chlorine. The viscosity (based on a solution of 20% by weight concentration in toluene at 20 °C) shall fall in the range of 9 to 14 centipoise, when measured according to ASTM D 445. Up to 50% by weight of the amount of chlorinated rubber could be of the viscosity of 17 to 25 centipoises, but spray application is more difficult.

[2] This pigment is to be used for the reference (i.e., control) paint. A lead and chromate free pigment may be used provided it meets performance requirements. Users of lead and chromate containing paints are urged to follow all health, safety, and environmental regulations in applying, handling or disposing of these materials.

**5.3 COLOR:** The color shall be consistent with the choice of inhibitive pigment and shall be obtained by using compatible, chemically resistant tinting pigments.

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when one volume of the paint is slowly mixed with one volume of xylene (FED-STD-41, Method 4203).

Solvent blends shall be checked in an unpigmented film deposited on glass. The dried film must be clear and bright. The flexibility and permeability of the trial film shall also be compared with that obtained from the "control formulation" paint.

**5.5 WORKING PROPERTIES:** The paint shall be easily applied by all three methods when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging after drying.

**5.6 CONDITION IN CONTAINER:** The paint shall show no thickening, curdling, gelling, or hard caking when tested

Provided by : www.spic.ir Licensee: NISOC Library

as specified in FED-STD-141, Method 3011, after storage for 12 months from date of delivery, in a full, tightly covered container, at a temperature of 50-110°F (10-43°C).

**5.7** When subjected to the tests described in Sections 5.8 through 5.12, the performance of the paint shall be equal to or better than the "control formulation" paint given in Table 4.

**5.8 FILM THICKNESS:** The primer shall be capable of being applied to produce a dry film thickness of 1.5 mils (38 micrometers) minimum without running or sagging. Depending upon the volume solids content, this will require a wet film thickness of approximately 5 mils (127 micrometers). Panels prepared for the working properties test under Section 5.5 may be used for these measurements. A minimum of five measurements shall be taken to calculate the average dry film thickness.

**5.9 SALT FOG TEST:** This test shall be performed in accordance with ASTM B 117. Panels shall be 3" x 6" x 1/8" (8 cm x 16 cm x 0.3 cm) cold-rolled steel, sandblasted in accordance with SSPC-SP 10, "Near-White Blast Cleaning," using 20-40 mesh silica sand. The primer shall be applied by spray to a 3.0 mil (76 micrometers) dry film thickness—approximately 9 mils (229 micrometers) wet film. After one week of drying at 70-80°F (21-27°C), the panels shall be scored as indicated in ASTM B 117. Panels shall be exposed in the cabinet at a 30 degree angle from the vertical. Panels shall be tested in duplicate and examined at 96-hour intervals for a period of 500 hours.

**5.10 FLEXIBILITY TEST:** This test shall be run in accordance with FED-STD-141, Method 6221. Panels shall be 3" x 6" (8 cm x 16 cm) 20 gage cold-rolled steel, cleaned in accordance with FED-STD-141, Method 2011, Procedure D, followed by Procedure A.

The primer shall be applied by spray to a 3.0 mil (76 micrometers) dry film thickness—approximately 9 mils (229 micrometers) wet film. After one week of drying at 70-80°F (21-27°C), the panel shall be bent over a 1-1/2" (4 cm) mandrel and shall show no cracking or loss of adhesion.

**5.11 EXTERIOR EXPOSURE:** Since exposure environments vary, exposure tests must be based on comparison with the "control formulation" paint. The proposed paint shall provide at least as much protection as the "control formulation" paint. Panels shall be 6" (16 cm) channel steel in a 12" (30 cm) long section and exposed at a 45 degree angle south exposure with the flanges horizontal. Each panel shall have a weld bead approximately 3" (8 cm) long placed at the left end of the panel about 3" (8 cm) from the end. The primer shall be applied by spray to a 3.0 mil (76 micrometers) dry film thickness—approximately 9 mils (230 micrometers) wet film. After one week of drying at 70- 80°F (21-27°C), the coated steel shall be scored in an "X" pattern on the right 3" (8 cm) from the end. Each stroke of the "X" must be 4" (10 cm) long. Then the panels shall be placed on exposure. After 60 days exposure, both the proposed and "control" paints shall show no blistering or rusting on the face and only minor blistering or rusting at the weld and score.

**5.12 FRESH WATER IMMERSION TEST:** Panels shall be 3" x 6" x 1/8" (8 cm x 16 cm x 0.3 cm) cold-rolled steel prepared according to SSPC-SP 10, "Near-White Blast Cleaning," using 20-40 mesh silica sand. The primer shall be applied by spray to a 3.0 mil (76 micrometers) dry film thickness—approximately 9 mils (229 micrometers) wet film. Half of the immersed area and half of the unimmersed area shall be coated with the selected topcoat system. After one week of drying at 70-80°F (21-27°C), the panels shall be partially immersed (halfway) in distilled water at 100°F (38°C). Panels shall be examined every 24 hours for blistering, leaching, rusting, or loss of adhesion. Both the proposed and "control" paints shall pass 500 hours immersion with no other defect than a slight discoloration (examine after a one-hour drying period).

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legible marked with the following information:

Name: Chlorinated Rubber Inhibitive
Specification: SSPC-Paint 17
Color:
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions use shall be supplied with each container of paint:

Directions for Use of Chlorinated Rubber Inhibitive Primer

This paint is intended for use as a primer on structural steel. Before applying remove all moisture, oil, grease, dirt, and loose or nonadhering paint. Rust, rust scale, mill scale, etc., shall be removed by abrasive blast cleaning in accordance with SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." Sound old coatings that are com-

Provided by : www.spic.ir Licensee: NISOC Library

patible with this chlorinated rubber paint may remain, but damaged areas or areas with poor adhesion must be spot-cleaned before priming. When the coating system is intended for immersion, the surface shall be cleaned in accordance with SSPC-SP 10, "Near-White Blast Cleaning," or SSPC-SP 8, "Pickling."

This primer is intended to be followed by an intermediate paint conforming to SSPC-Paint 18, "Chlorinated Rubber Intermediate Coat Paint," and/or a finish coat conforming to SSPC-Paint 19, "Chlorinated Rubber Topcoat Paint." The entire system is designed to provide maximum chemical resistance. In more severe environments, a second prime coat is recommended.

Mix paint thoroughly before use. If simple stirring is inadequate, pour off most of the liquid into a clean container. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring contents to a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

Generally thinners are not used for brush application. For spray application, the coating may be thinned with xylene up to 1-1/2 pints per gallon (190 ml/L) of unthinned paint. A by volume blend of 80% minimum of xylene and 20% maximum of an aliphatic solvent having an evaporation rate faster than that of xylene may be used instead of straight xylene.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 1.5 mils (38 micrometers) dry or approximately 5 mils (127 micrometers) wet. When application is by spraying, the equipment and operator technique should be properly adjusted to prevent dry spray and to deposit a wet film of paint on the substrate. Clean the equipment with xylene or the reducing thinner both before and after use.

The surface to be painted shall be dry and the surface temperature shall be at least 5°F (3°C) above the dew point. When no ice or frost is present on the substrate, this coating may be applied at temperatures as low as 5°F (-15°C). Do not paint outdoors if precipitation, dew, or condensation is expected before the paint dries.

At temperatures of 50-80°F (15-27°C) and relative humidities of 40% to 60%, allow at least three hours drying time between coats. Allow at least 48 hours of drying time after the last coat is applied before placing in water immersion service. If the temperature is below 60°F (16°C) or if the relative humidity is above 60°F (16°C) or if the relative humidity is above 60%, allow 4 to 7 days before placing in water immersion service.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 18

## Chlorinated Rubber Intermediate Coat Paint

### 1. Scope

**1.1** This specification covers a fast drying chlorinated rubber intermediate paint, available in white or tints, intended for use as either an intermediate coat or topcoat over a chlorinated rubber primer or other suitable primers. It has good durability when exposed to exterior environments but may show some tendency to chalk. This coating may be used on exterior non-submerged surfaces, as well as most submerged surfaces. This coating is not recommended for areas exposed to strong organic solvents, oxidizing acids, or areas where the surface temperature exceeds 165°F (74°C). Straight chain unsaturated acids and fats and oils of animal or vegetable origin will cause softening and swelling of the coating.

**1.2** This coating, when applied over properly primed steel surfaces and followed by at least one (optional) finish coat of SSPC-Paint 19, "Chlorinated Rubber Topcoat Paint," is suitable for exposures in Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 2C (fresh water immersion), 2D (salt water immersion), 3A (chemical, acid), 3B (chemical, neutral), and 3C (chemical, alkaline).

**1.3** This paint is intended for application by brush, roller, or spray and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**1.4** The preferred types of primers for use under this coating and on steel surfaces include chlorinated rubber (SSPC-Paint 17), modified chlorinated rubber, chemically cured epoxy, zinc-rich, and others specifically recommended by the manufacturer. Recoat of each primer should conform to the manufacturer's directions. Where a zinc-rich primer is used and the system is considered for water-immersion services, a sealcoat between the primer and this intermediate coat may be required to eliminate blistering.

**1.5** If this coating is applied over alkyd- or oil-base enamels, there is the possibility of lifting, particularly on interior surfaces. A spot check is necessary to determine suitability. If lifting occurs, then a seal-coat, as recommended by the manufacturer, may be required. For immersion service, this coating should not be applied over alkyd- or oil-base enamels.

### 2. Description

**2.1** This coating is a mixture of white pigments, tinting pigments, chlorinated rubber, chlorinated resins, plasticizers, and solvents. Details of the composition are given in Table 1.

**2.2** This paint contains approximately 35% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 3.0 mil (76 micrometers) dry film thickness is 190 square feet/U.S. gallon (4.6 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **Paint 17** | Chlorinated Rubber Primer |
| **Paint 19** | Chlorinated Rubber Topcoat Paint |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 13** | Specification for Spirits of Turpentine |
| **D 185** | Test Methods for Coarse Particles in Pigments, Pastes, and Paints |
| **D 445** | Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity) |
| **D 476** | Specification for Titanium Dioxide Pigments |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**COMPOSITION**

| INGREDIENTS | REQUIRED Min. Wt. % | REQUIRED Max. Wt. % | TYPICAL COMPOSITION Wt.% | TYPICAL COMPOSITION Vol.% | INGREDIENT STANDARDS ASTM | INGREDIENT STANDARDS Federal |
|---|---|---|---|---|---|---|
| PIGMENT: (23 ± 7 wt. %) | | | | | | |
| Titanium Dioxide | 10.0 | — | 4.0 | 1.3 | D 476, Type IV | — |
| Tinting Pigments[1] | — | 3.0 | 0.4 | 0.3 | — | — |
| Extender Pigments: | | | | | | |
| Magnesium Silicate | 50.0 | 65.0 | 15.6 | 7.3 | D 605 | — |
| Mica | 8.0 | 25.0 | 6.4 | 2.9 | D 607 | — |
| VEHICLE: (77 ± 7 wt. %) | | | | | | |
| Chlorinated Rubber[2] | 23.0 | 30.0 | 20.1 | 15.5 | — | — |
| Chlorinated Hard Resins | — | — | 5.0 | 4.0 | — | MIL-C-429, Type II |
| Chlorinaed Plasticizers | 8.0 | 22.0 | 10.0 | 11.0 | — | MIL-C-429, Type I |
| Plasticizer[3] | — | — | — | | — | — |
| Solvents[4] | — | 65.0 | 37.0 | 37.0 | 56.2 | — |
| Vehicle Stabilizers[5] | 0.7 | — | 0.6 | 0.7 | — | — |
| Vapor Phase Stabilizers[6] | 0.3 | — | 0.2 | 0.3 | — | — |
| Suspending Aids[7] | 0.5 | 2.0 | 0.7 | 1.5 | — | — |
| TOTALS | | | 100.0 | 100.0 | | |

1 Lampblack or lightfast and compatible, chemically resistant colored pigments shall be used to provide a tint or color when desired. NOTE: When this paint is to be used in a paint system to the interior of potable water vessels, the ingredients used shall not be deemed objectionable for such use by the U.S. Environmental Protection Agency or any agency that would have jurisdiction over such matters.

2 The chlorinated rubber shall contain approximately 66% by weight chlorine. The viscosity (based on a solution of 20% by weight concentration in toluene at 20°C) shall fall in the range of 9 to 14 centipoise, when measured according to ASTM D 445. Up to 50% by weight of the amount of chlorinated rubber could be of the viscosity range of 17 to 25 centipoises, but spray application is more difficult.

3 Alternative plasticizers can be used, provided they are compatible, high quality, and chemically resistant.

4 The solvent shall consist of aromatic or a blend of aromatic and aliphatic hydrocarbons, with the aliphatic portion limited to 25% by weight, and shall have a minimum kauri butanol value of 75. Up to 10% by weight of turpentine (ASTM D 13) or other high-boiling aromatic type solvents may be added to improve application properties.

5 The vehicle stabilizer shall be a mixture of four parts zinc oxide and one part pentaerythritol. Other suitable chloride acceptors, such as an epoxidized vegetable oil, may be used.

6 A vapor-phase stabilizer, such as propylene oxide, can also be used. It must be a high-grade commercial material suitable for the intended purpose.

7 The suspending aid shall be hydrogenated castor oil or montmorillonite mineral.

| | | | |
|---|---|---|---|
| **D 605** | Specification for Magnesium Silicate Pigment (Talc) | **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 607** | Specification for Wet Ground Mica Pigments | **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1208** | Test Methods for Common Properties of Certain Pigments | **D 1542** | Test Method for Qualitative Detection of Rosin in Varnishes |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems | **D 3278** | Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus |

Provided by : www.spic.ir Licensee: NISOC Library

**D 3925** Practice for Sampling Liquid Paints and Related Pigmented Coatings

**3.6 FEDERAL STANDARDS:**

**MIL-C-429** Chlorinated Paraffin, Technical

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

**Method 2011** Preparation of Steel Panels
**Method 3011** Condition in Container
**Method 4021** Pigment Content (Ordinary Centrifuge)
**Method 4053** Nonvolatile Vehicle Content
**Method 4061** Drying Time
**Method 4203** Reducibility and Dilution Stability
**Method 4321** Brushing Properties
**Method 4331** Spraying Properties
**Method 4541** Working Properties and Appearance of Dried Film

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

**Z129.1** Hazardous Industrial Chemicals – Precautionary Labeling

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1.

**4.2** The paint based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. No rosin or rosin derivatives may be used. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added.

**4.3** The paint shall conform to the composition (analysis) requirements of Table 2.

**TABLE 2**
**ANALYSIS**

| | REQUIREMENTS | | | |
|---|---|---|---|---|
| **CHARACTERISTICS** | **Min.** | **Max.** | **ASTM** | **FED-STD-141** |
| Pigment and extender | 16.0 | 30.0 | D 1208 | 4021 |
| Volatiles | — | 54.6 | D 1208 | — |
| Nonvolatile vehicle | 22.0 | — | — | 4053 |
| Uncombined water | — | 0.25 | D 1208 | — |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 0.05 | D 185 | — |
| Rosin or rosin derivatives | — | 0 | D 1542 | — |

**TABLE 3**
**PROPERTIES**

| | REQUIREMENTS | | | |
|---|---|---|---|---|
| **CHARACTERISTICS** | **Min.** | **Max.** | **ASTM** | **FED-STD-141** |
| Viscosity* shear rate 200 rpm Kreb units | 75 | 100 | D 562 | — |
| Weight per U.S. gallon, pounds | 10.0 (1.2 kg/L) | 11.3 (1.4 kg/L) | D 1475 | — |
| Fineness of grind, Hegman units | 5.0 | — | D 1210 | — |
| Dryint time: | | | | |
| Set to Touch, minutes | 15 | — | — | 4061 |
| Dry hard, hours | 1 | — | — | 4061 |
| Flash Point, degrees F | 80 (27°C) | — | D 3278 | — |

*Viscosity 48 hours or more after manufacture.

Provided by : www.spic.ir Licensee: NISOC Library

## 5. Properties

**5.1** The paint shall meet the requirements of Table 3 and Sections 5.2 through 5.6.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**5.3 COLOR:** The color, or contrasting shade, shall be obtained by using compatible, chemically resistant tinting pigments.

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when one volume of paint is slowly mixed with one volume of xylene (FED-STD-141, Method 4203).

Solvent blends shall be checked in an unpigmented film deposited on glass. The dried film must be clear and bright. The flexibility and permeability of the trial film shall also be compared with that obtained from the "typical formulation" paint.

**5.5 WORKING PROPERTIES:** The paint shall be easily applied by all three methods when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging after drying.

**5.6 CONDITION IN CONTAINER:** The paint shall show no thickening, curdling, gelling, or hard caking when tested as specified in FED-STD-141, Method 3011, after storage for 12 months from date of delivery, in a full, tightly covered container, at a temperature of 50-110°F (10-43°C).

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeline Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legibly marked with the following information:

Name: Chlorinated Rubber Intermediate Coat Paint
Specification: SSPC-Paint 18
Color:
Lot Number:
Stock Number:
Date of Manufacturer:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of Chlorinated Rubber Intermediate Coat Paint

This paint is intended for use as an intermediate coat or topcoat over rust inhibitive chlorinated rubber primer or other suitable primers on structural steel. Before applying, removal all moisture, oil, grease, dirt, and loose or nonadhering paint. Sound old coatings that are compatible with this chlorinated rubber paint may remain, but damaged areas or areas of poor adhesion must be spotcleaned and spot-primed.

Preferred primers are chlorinated rubber, modified chlorinated rubber, chemically cured epoxy, zinc-rich, and others specifically recommended by the manufacturer. Where a zinc-rich primer is used and the system is considered for water-immersion service, a seal-coat between the primer and this intermediate or topcoat paint may be required to eliminate blistering.

Contaminated prime coats shall be cleaned by appropriate methods before application of succeeding coats.

Mix paint thoroughly before use. If simple stirring is inadequate pour off most of the liquid into a clean container. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring contents of a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

Generally, thinners are not used for brush application. For spray application, the coating may be thinned with xylene up to 1-1/2 pints per gallon (190 ml/L) of unthinned paint. A by volume blend of 80% minimum of xylene and 20% maximum of an aliphatic solvent having an evaporation rate faster than that of xylene may be used instead of straight xylene.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 3.0 mils (75 micrometers) dry or approximately 9 mils (225 micrometers) wet. When application is by spraying, the equipment and operator technique should be properly adjusted to prevent dry spray and to deposit a wet film of paint on the substrate. Clean the equipment with xylene or the reducing thinner both before and after use.

The surface to be painted shall be dry and the surface temperature shall be at least 5°F (3°C) above the dew point. When no ice or frost is present on the substrate, this coating may be applied at temperatures as low as 5°F (-15°C). Do not paint outdoors if precipitation, dew, or condensation is expected before the paint dries.

At temperatures of 50-80°F (15-27°C) and relative humidities of 40% to 60% allow at least three hours drying time between coats. Allow at least 48 hours of drying time after the last coat is applied before placing in water immersion service. If the temperature is below 60°F (16°C) or if the

Provided by : www.spic.ir Licensee: NISOC Library

relative humidity is above 60%, allow 4 to 7 days before placing in water immersion service.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 19
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 19

## Chlorinated Rubber Topcoat Paint

### 1. Scope

**1.1** This specification covers a fast drying chlorinated rubber topcoat paint, available in white or tints, intended for use as either a topcoat or intermediate coat over a chlorinated rubber intermediate, chlorinated rubber primer, or another suitable primer. It has good durability when exposed to exterior environments, but may show some tendency to chalk. This coating may be used on exterior nonsubmerged surfaces, as well as most submerged surfaces. This coating is not recommended for areas exposed to strong organic solvents, oxidizing acids, or to areas where the surface temperature exceeds 165°F (74°C). Straight chain unsaturated acids, and fats and oils of animal or vegetable origin will cause softening and swelling of the coating.

**1.2** This coating is suitable for exposures in Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 2C (fresh water immersion), 2D (salt water immersion), 3A (chemical, acid), 3B (chemical, neutral), and 3C (chemical, alkaline).

**1.3** This paint is intended for application by brush, roller, or spray and is to be applied in accordance with SSPC-PA 1, “Shop, Field, and Maintenance Painting of Steel.”

**1.4** The preferred types of primers for use under this coating and on steel surfaces include chlorinated rubber (SSPC-Paint 17), modified chlorinated rubber, chemically cured epoxy, zinc-rich, and others specifically recommended by the manufacturer. Recoat of each primer should conform to the manufacturer’s directions. Where a zinc-rich primer is used and the system is considered for water-immersion services, a seal coat between the primer and this intermediate coat may be required to eliminate blistering.

**1.5** If this coating is applied over alkyd or oil-base enamels, there is the possibility of lifting, particularly on interior surfaces. A spot check is necessary to determine suitability. If lifting occurs, then a seal coat, as recommended by the manufacturer, may be required. For immersion service, this coating should not be applied over alkyd or oil-base enamels.

### 2. Description

**2.1** This coating is a mixture of colored pigments, tinting pigments, chlorinated rubber, chlorinated resins, plasticizers, and solvents. Details of the composition are given in Table 1.

**2.2** This paint contains approximately 35% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 1.5 mil (38 micrometers) dry film thickness is 375 square feet/U.S. gallon (9.2 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **Paint 17** | Chlorinated Rubber Primer |
| **Paint 18** | Chlorinated Rubber Intermediate Coat Paint |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 13** | Specification for Spirits of Turpentine |
| **D 185** | Test Methods for Coarse Particles in Pigments, Pastes, and Paints |
| **D 445** | Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity) |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 1208** | Test Methods for Common Properties of Certain Pigments |

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**COMPOSITION**

| INGREDIENTS | REQUIRED Min. Wt. % | REQUIRED Max. Wt. % | TYPICAL COMPOSITION Wt.% | TYPICAL COMPOSITION Vol.% | INGREDIENT STANDARDS ASTM | INGREDIENT STANDARDS Federal |
|---|---|---|---|---|---|---|
| PIGMENT: (23 ± 5 wt. %) | | | | | | |
| Colored or Tinting Pigment[1] | 90.0 | — | 26.8 | 9.1 | — | — |
| Extender Pigments[1] | — | 10.0 | 0.3 | 0.2 | — | — |
| VEHICLE: (77 ± 5 wt. %) | | | | | | |
| Chlorinated Rubber[2] | 20.0 | 32.0 | 23.2 | 19.2 | — | — |
| Chlorinated Resin | — | — | 5.6 | 4.8 | — | MIL-C-429, Type II |
| Chlorinated Plasticizers | 8.0 | 22.0 | 9.2 | 10.9 | — | MIL-C-429, Type I |
| Plasticizer[3] | — | — | 2.3 | 3.5 | — | — |
| Solvent[4] | — | 64.0 | 31.6 | 51.1 | — | — |
| Vehicle Stabilizers | 0.5 | — | 0.7 | 0.8 | — | — |
| Vapor Phase Stabilizers[6] | 0.2 | — | 0.2 | 0.3 | — | — |
| Suspending Aids[7] | 0.1 | — | 0.1 | 0.1 | — | — |
| TOTALS | | | 100.0 | 100.0 | | |

1 Lightfast and compatible chemically resistant colored pigments shall be used to provide a tint or color when desired. Extender pigments must be compatible and chemically resistant. NOTE: When this paint is to be used in a paint system applied to the interior of potable waste vessels, the ingredients used shall not be deemed objectionalbe for such use by the U.S. Environmental Protection Agency or any agency that would have jurisdiction over such matters.

2 The chlorinated rubber shall contain approximately 66% by weight chlorine. The viscosity (based on a solution of 20% by weight concentration in toluene at 20°C) shall fall in the range of 9 to 14 centipoise, when measured according to ASTM D 445. Up to 50% by weight of the amount of chlorinated rubber could be of the viscosity range of 17 to 25 centipoises, but spray application is more difficult.

3 Alternative plasticizers can be used, provided they are compatible, high quality, and chemically resistant.

4 The solvent shall consist of aromatic or a blend of aromatic and aliphatic hydrocarbons, with the aliphatic portion limited to 25% by weight, and shall have a minimum kauri butanol value of 75. Up to 10% by weight of turpentine (ASTM D 13) or other high-boiling aromatic type solvents may be added to improve application properties.

5 The vehicle stabilizer shall be a mixture of four parts of zinc oxide and one part pentaerythritol. Other suitable chloride acceptors, such as an epoxidized vegetable oil, may be used.

6 A vapor-phase stabilizer, such as propylene oxide, can also be used. It must be a high-grade commercial material suitable for the intended purpose.

7 The suspending aid shall be hydrogenated castor oil or montmorillonite mineral.

**D 1210** Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems

**D 1296** Test Method for Odor of Volatile Solvents and Diluents

**D 1475** Test Method for Density of Paint, Varnish, Lacquer, and Related Products

**D 1542** Test Method for Qualitative Detection of Rosin in Varnishes

**D 3278** Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus

**D 3925** Practice for Sampling Liquid Paints and Related Pigmented Coatings

**3.6 FEDERAL STANDARDS:**

**MIL-C-429** Chlorinated Paraffin, Technical

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **Method 2011** | Preparation of Steel Panels |
| **Method 3011** | Condition in Container |
| **Method 4021** | Pigment Content (Ordinary Centrifuge) |
| **Method 4053** | Nonvolatile Vehicle Content |
| **Method 4061** | Drying Time |
| **Method 4203** | Reducibility and Dilution Stability |
| **Method 4321** | Brushing Properties |
| **Method 4331** | Spraying Properties |
| **Method 4541** | Working Properties and Appearance of Dried Film |
| **Method 6221** | Flexibility |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals — Precautionary Labeling |

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1.

**4.2** The paint based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. No rosin or rosin derivatives may be used. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added.

**4.3** The paint shall conform to the composition (analysis) requirements of Table 2.

## 5. Properties

**5.1** The paint shall meet the requirements of Table 3 and Sections 5.2 through 5.6.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**TABLE 2**
**ANALYSIS**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | Max. Wt. % | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Pigment | 18.0 | 28.0 | D 1208 | 4021 |
| Volatiles | — | 53.0 | D 1208 | — |
| Nonvolatile vehicle | 20.0 | — | — | 4053 |
| Uncombined water | — | 0.25 | D 1208 | — |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 0.05 | D 185 | — |
| Rosin or rosin derivaties | — | 0 | D 1542 | — |

**TABLE 3**
**PROPERTIES**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Viscosity* shear rate 200 rpm Kreb units | 65 | 80 | D 562 | — |
| Weight per U.S. gallon, pounds | 8.5 (1.0 kg/L) | 12.0 (1.4 kg/L) | D 1475 | — |
| Fineness of grind, Hegman units | 6.0 | — | D 1210 | — |
| Drying time: | | | | |
| Set to Touch, minutes | 15 | — | — | 4061 |
| Dry hard, hours | 1 | — | — | 4061 |
| Flash Point, degrees F | 80 (27°C) | — | D 3278 | — |

*Viscosity 48 hours or more after manufacture.

Provided by : www.spic.ir Licensee: NISOC Library

**5.3 COLOR:** The color, or contrasting shade, shall be obtained by using compatible chemically resistant tinting pigments.

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when one volume of paint is slowly mixed with one volume of xylene (FED-STD-141, Method 4203).

Solvent blends shall be checked in an unpigmented film deposited on glass. The dried film must be clear and bright. The flexibility and permeability of the trial film shall also be compared with that obtained from the "typical formulation" paint

**5.5 WORKING PROPERTIES:** The paint shall be easily applied by all three methods when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging after drying.

**5.6 CONDITION IN CONTAINER:** The paint shall show no thickening, curdling, gelling, or hard.caking when tested as specified in FED-STD-141, Method 3011, after storage for 12 months from date of delivery, in a full, tightly covered container, at a temperature of 50-110°F (10-43°C).

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legibly marked with the following information:

Name: Chlorinated Rubber Topcoat Paint
Specification: SSPC-Paint 19
Color:
Lot Number:
Stock Number:
Date of Manufacturer:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions use shall be supplied with each container of paint:

Directions for Use of Chlorinated Rubber Topcoat Paint

This paint is intended for use as an intermediate or finish coat over rust inhibitive chlorinated rubber primer or other suitable primers on structural steel. Before applying, remove all moisture, oil, grease, dirt and loose or nonadhering paint. Sound old coatings that are compatible with this chlorinated rubber paint may remain, but damaged areas or areas of poor adhesion must be spotcleaned and spot-primed.

Preferred primers are chlorinated rubber, modified chlorinated rubber, chemically cured epoxy, zinc-rich, and others specifically recommended by the manufacturer. Where a zinc-rich primer is used and the system is considered for water-immersion service, a seal coat between the primer and this intermediate or topcoat paint may be required to eliminate blistering. Contaminated prime coats shall be cleaned by appropriate methods before application of succeeding coats.

Mix paint thoroughly before use. If simple stirring is inadequate, pour off most of the liquid into a clean container. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring contents to a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

Generally, thinners are not used for brush application. For spray application, the coating may be thinned with xylene up to 1-1/2 pints per gallon (190 ml/L) of unthinned paint. A by volume blend of 80% minimum of xylene and 20% maximum of an aliphatic solvent having an evaporation rate faster than that of xylene may be used instead of straight xylene.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 1.5 mils (38 micrometers) dry or approximately 4 mils (102 micrometers) wet. When application is by spraying, the equipment and operator technique should be properly adjusted to prevent dry spray and to deposit a wet film of paint on the substrate. Clean the equipment with xylene or the reducing thinner both before and after use.

The surface to be painted shall be dry and the surface temperature shall be at least 5°F (3°C) above the dew point. When no ice or frost is present on the substrate, this coating may be applied at temperatures as low as 5°F (-15°C). Do not paint outdoors if precipitation, dew, or condensation is expected before the paint dries.

At temperatures of 50-80°F (15-27°C) and relative humidities of 40% to 60% allow at least three hours drying time between coats. Allow at least 48 hours of drying time after the last coat is applied before placing in water immersion service. If the temperature is below 60°F (16°C) or if the relative humidity is above 60%, allow 4 to 7 days before placing in water immersion service.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the

Provided by : www.spic.ir Licensee: NISOC Library

right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 20

## Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic")

### 1. Scope

**1.1** This specification covers one group of highly pigmented zinc-rich coatings that are uniquely defined by their capability of galvanically protecting steel exposed at discontinuities such as narrow scratches and holidays. While the major pigment component in this coating is zinc dust, the vehicle may be inorganic (Type I) or organic (Type II).

**1.2** This specification does not cover all types of zinc-rich coatings. For example, it is not a straight performance specification, nor does it pertain to extended zinc-rich coatings, nor to weldable pre-fabrication zinc-rich primers, which are applied at low thicknesses (approximately one mil [25 micrometers] or less). Further information regarding these and other zinc-rich coatings can be found in SSPC-PS Guide 12.00, "Guide to Zinc-Rich Painting Systems," and other SSPC specifications.

**1.3** This specification defines the minimum compositional and laboratory performance requirements for identifying a group of zinc-rich paints. It is to be used in conjunction with SSPC-PS Guide 12.00, "Guide to Zinc-Rich Painting Systems"; and with other SSPC specifications covering surface preparation, applications, thickness, inspection, and safety.

**1.4** This primer, when applied over properly prepared steel surfaces, is suitable for use on parts or structures exposed in Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water), and 2C (fresh water immersion). They may be used in Environmental Zones 2B (frequently wet by salt water), 2D (salt water immersion), 3A (chemical, acidic), and 3C (chemical, alkaline) with proper topcoating.

**1.5** This primer is intended for application by spray and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

### 2. Description

**2.1** The zinc-rich coatings described in this specification consist of zinc dust, an organic or inorganic vehicle, and selected additives as required.

**2.2 PIGMENTATION:**

**2.2.1** The major pigment component in these coatings is zinc dust of the type described in ASTM D 520, "Zinc Dust (Metallic Zinc Powder)."

**2.2.2** Other pigment components may include curing aids, tinting colors, suspension and pot life control agents, but should constitute only a minor part of the total pigment portion so as not to detract from the ability of these coatings to protect galvanically.

**2.3 VEHICLE TYPES:**

**2.3.1** Type I-A, inorganic post-curing vehicles—water soluble, include alkali metal silicates, phosphates, and modifications thereof which must be subsequently cured by application of heat or a solution of a curing compound.

**2.3.2** Type I-B, inorganic self-curing vehicles—water reducible, include water soluble alkali metal silicates, quarternary ammonium silicates, phosphates, and modifications thereof. These coatings cure by crystallization after evaporation of water from the coating.

**2.3.3** Type I-C, inorganic self-curing vehicles—solvent reducible, include titanates, organic silicates, and polymeric modifications of these silicates. These systems are dependent upon moisture in the atmosphere to complete hydrolysis, forming the polysilicate.

**2.3.4** Type II, organic vehicles—include phenoxies, catalyzed epoxies, urethanes, chlorinated rubbers, styrenes, silicones, vinyls, and other suitable resinous binders. The organic vehicles covered by this specification may be chemically cured or may dry by solvent evaporation. Under certain conditions heat may be used to facilitate or accelerate hardening.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**REQUIREMENTS**

| CHARACTERISTISCS[1] | MINIMUM REQUIREMENTS Inorganic | MINIMUM REQUIREMENTS Organic | STANDARDS ASTM |
|---|---|---|---|
| Total Solids, % by weight of paint | 78 | 70 | D 2369 |
| Pigment, % by weight of total solids | 85 | 83 | D 2371 |
| Total zinc dust[2], % by weight of pigment | 87 | 93 | D 521 |
| Total zinc dust[2], % by weight of total solids | 74 | 77 | — |

[1] The minimum composition requirements of a zinc-rich paint is controversial. It is recognized that zinc-rich primers containing extenders, although having less total zinc dust than specified, may be able to pass all other requirements of this specification. However, these compositional requirements are necessary, as certain non-zinc containing coatings may also be able to pass all other requirements of this specification.

[2] Zinc dust shall meet ASTM D 521.

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

**PA 1** Shop, Field, and Maintenance Painting of Steel
**PA Guide 3** A Guide to Safety in Paint Application
**PS 12.01** One-Coat Zinc-Rich Painting System
**PS Guide 12.00** Guide to Zinc-Rich Coating Systems
**SP 5/NACE No. 1** White Metal Blast Cleaning

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

**A 36** Specification for Carbon Structural Steel
**B 117** Practice for Operating Salt Spray (Fog) Apparatus
**D 56** Test Method for Flash Point by Tag Closed Tester
**D 185** Test Methods for Coarse Particles in Pigments, Pastes, and Paints
**D 521** Test Methods for Chemical Analysis of Zinc Dust (Metallic Zinc Powder)
**D 562** Test Method for Consistency of Paints Using the Stormer Viscometer
**D 1200** Test Method for Viscosity by Ford Viscosity Cup
**D 1308** Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
**D 2369** Test Method for Volatile Content of Coatings
**D 2371** Test Method for Pigment Content of Solvent-Reducible Paints
**D 3359** Test Methods for Measuring Adhesion by Tape Test
**D 3925** Practice for Sampling Liquid Paints and Related Pigmented Coatings

**3.6 FEDERAL STANDARDS:**

**PPP-P-1892** Paint, Varnish, Lacquer, and Related Materials; Packaging, Packing and Marking of

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

**Method 4331** Spraying Properties
**Method 4541** Working Properties and Appearance of Dried Film

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

**Z129.1** Hazardous Industrial Chemicals—Precautionary Labeling

## 4. Composition

**4.1** The paint shall conform to the composition (analysis) requirements of Table 1. This table defines the minimum compositional requirements of these zinc-rich paints without specifying the vehicle.

## 5. Qualitative Requirements

**5.1** The paint shall meet the qualitative requirements Sections 5.2 through 5.10.

Provided by : www.spic.ir Licensee: NISOC Library

**5.2 MIXING:** The raw materials of the liquid portion of either the inorganic or organic multi-component paints shall be mixed and dispersed as required to produce a product which is uniform, stable, free from grit, and conforms to the requirements of this specification.

The pigment portion of multi-component paints, prior to mixing, shall be dry and loosely packed.

The ready-mixed paint shall be capable of being broken up with a paddle to a smooth, uniform consistency and shall not liver, thicken, curdle, gel, or hard settle, nor show any other objectionable properties in a mixed, freshly opened container.

After mixing, all types of coarse particles and skins as residue retained on a standard 60 mesh screen shall be no more than 0.5% by weight of total paint, regardless of type, in accordance with ASTM D 185.

**5.3 POT LIFE**: The pot life of the zinc-rich paint, when mixed and ready for application in accordance with manufacturer's instructions, shall be a minimum of four hours at 70°F (2°C) and 50% relative humidity. Although physical properties (viscosity, etc.) may not change, loss of pot life is indicated by lack of adhesion when tested in accordance with Section 5.8. Good practice has been that multicomponent zinc-rich paint be used within 12 hours after mixing.

**5.4 STORAGE LIFE:** Neither the vehicle of the multi-component paint nor the ready-mixed paint shall show thickening, curdling, gelling, gassing, or hard caking after being stored unmixed for six months from date of delivery in a tightly covered unopened container at a temperature of 50-90°F (10-32°C).

**5.5 WORKING PROPERTIES:** The mixed paint shall spray easily, and show no streaking, running, sagging, or other objectionable features when tested in accordance with FED-STD-141, Methods 4331 and 4541.

**5.6 TEST PANEL PREPARATION:** Steel test panels (ASTM A 36 hot rolled steel or equivalent), measuring 4"x 6"x 1/16" (10 cm x 15 cm x 1.5 mm) or greater, shall be white metal blast cleaned (SSPC-SP 5) with a nominal anchor profile from 1.5-3.5 mils (38-88 micrometers) (Section 10.4) and coated with the zinc-rich paint. The panels shall be blast cleaned and coated on both sides and all edges. The paint shall be spray applied and hardened in accordance with manufacturer's recommendations. The dry film thickness shall be 2.5-3.5 mils (64-88 micrometers) unless otherwise designated. Prior to any exposure testing, all panels shall be aged for 14 days at 75-79°F (24-26°C) and 45-55% relative humidity.

**5.7 MUDCRACKING:** The coating when applied in accordance with Section 5.6 to a five to six mil (125-150 micrometers) dry film thickness, shall show no mudcracking when viewed under 10X magnifications.

**5.8 ADHESION:** The coating when applied and hardened in accordance with Section 5.6, shall adhere to the steel substrate when subjected to the "Cross-Cut/Tape Test" (ASTM D 3359, Method B).

There shall be no separation of the paint film, or delamination of an entire square. Spalling loss of adhesion around the perimeter due to cutting of each square is acceptable.

Adhesion rating should be no less than 4B grading when evaluated according to the procedure of ASTM D 3359, Method B.

**5.9 SALT FOG RESISTANCE:** The coating, when applied and hardened in accordance with Section 5.6 and scribed as described below, shall pass 1,000 hours minimum exposure to salt fog (ASTM B 117) without any blistering or rusting of the coated portion, with no undercutting from the scribe. (Slight rusting in the scribe mark will be permissible and resulting staining should be ignored.) Strips 1/4" (6 mm) wide along the edges of the panel may be ignored. Testing shall be done in triplicate.

The scribe mark shall be centrally positioned in the lower half of the panel and shall consist of an "X" comprising the diagonals of a 2" x 2" (5 x 5 cm) square. To insure proper positioning, cleanliness and depth of scribe mark, a template and scriber or cutting tool having a cutting edge at least 1 /32" (0.8 mm) wide shall be used. The operator shall bear down hard and go over each arm of the cut twice to insure a clean scribe of sufficient depth to remove any zinc particles from the scribe and to expose clean steel.

**5.10 ADDITIONAL RESISTANCE TESTS:** Additional screening qualification tests may be required by the user (Section 10.8).

## 6. Material Quality Assurance

**6.1** In order to determine the acceptability of a lot or batch of a qualified product, the paint shall meet the requirements of Sections 6.2 through 6.4.

**6.2** Viscosity of the mixed paint shall be determined in accordance with ASTM D 562. Variance shall be within ±5 Krebs Units or equivalent units of another viscometer of the viscosity of the previously qualified paint.

For viscosities lower than 55 K.U., a 4 Ford Cup shall be used in accordance with ASTM D 1200. Variations shall be within ±5 seconds of the viscosity of the previously qualified paint.

**6.3** Weight per gallon of the mixed paint shall be determined in accordance with ASTM D 1475. Variance shall be within ±0.4 pounds (180 g) of the nominal weight per gallon of the previously qualified paint.

Provided by : www.spic.ir Licensee: NISOC Library

**6.4** Solids percent by weight of the mixed paint shall be determined in accordance with ASTM D 2369. The percent solids by weight shall be no less than that specified in Table 1. Variance shall be within ±2% of the nominal percent solids by weight of the previously qualified paint.

**6.5** Other tests may be used to determine the acceptability of a lot or batch of a qualified product at the discretion of the user.

## 7. Labeling

**7.1** Refer to ANSI Standard Z129.1, "Industrial Hazardous Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**7.2 MARKING OF CONTAINER:** Each container shall be legibly marked with the following information:

Name: Zinc-Rich Primer
Specification: SSPC-Paint 20, Type
Component:
Color:
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**7.3 PACKAGING:** The pigment portion of multicomponent zinc-rich paints shall be packaged separately to be mixed with the liquid portion shortly before use. Each container of liquid shall be packaged and labeled in accordance with the requirements of Federal Specification PPP-P-1892 and shall include directions showing correct proportions of liquid to pigment along with necessary mixing instructions. The packaging of single component zinc-rich paints, Types I and II, shall also comply with the above Federal Specification.

**7.4 DIRECTIONS FOR USE:** The manufacturer shall supply complete instructions covering uses, surface preparation, mixing, thinning, application method, application conditions, pot life, wet and dry film thicknesses, temperature and humidity limitations, drying times, etc. with each container of paint.

## 8. Inspection

**8.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 10.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**8.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**8.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 9. Disclaimer

**9.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**9.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 10. Notes

Notes are not requirements of this specification.

**10.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**10.2 COVERAGE:** Except for special cases, most zinc-rich primers are formulated to apply at nominal dry film thicknesses of 2.5-3.5 mils (64-88 micrometers). In actual practice a coverage of 150 to 300 square feet per gallon (3.7- 7.4 square meters per liter) will be expected over flat blast cleaned surfaces.

**10.3 FLASH POINT:** The minimum flash point, as determined by the Tag closed cup (ASTM D 56) should be "none" for inorganic water base zinc-rich coatings, and a minimum of 55°F (13°C) for solvent base inorganic zincs (Type I-C) and 50°F (10°C) for organic zincs (Type II).

Provided by : www.spic.ir Licensee: NISOC Library

Specific applications, such as the interior of tanks, holds, and other confined spaces normally require a minimum flash point of 100°F (38°C).

**10.4** A Surface Profile Comparator is available from SSPC for sand, grit, and shot blast cleaned surfaces. Alternatively, replica tape, depth micrometer, stylus, microscopic measurement methods, or other suitable techniques may be used.

**10.5** Inorganic zinc-rich paints Types I-A and I-B should not be stored at temperatures below 40°F (4°C). Furthermore, storage of all zinc-rich paints above 90°F (32°C) should be avoided.

**10.6** Inorganic zinc-rich primers (Types I-A and I-B) should not be applied at surface temperatures below 40°F (4°C). Type I-C should not be applied at relative humidities below 50%, without specific instructions from the paint manufacturer.

**10.7** Multiple component zinc-rich paints should be applied within four hours after mixing and should be continuously agitated during application.

**10.8 ADDITIONAL RESISTANCE TESTS:** Because of the diversity of potential service environments, this specification may require the zinc-rich primer be further exposed and qualified by at least one additional test relating to the intended exposure. For example, if the intended service is a petroleum tanker cargo hold which is ballasted with sea water, appropriate test requirements other than those already specified might be:

- Salt Water Immersion (1,000 hours) ASTM D 1308
- Oil Immersion (1,000 hours) ASTM D 1308 or a cycling combination of both

Comparative testing of all candidate zinc-rich primers will be more meaningful than individual testing of each primer.

Standard tests which may be useful for further qualification are available from a number of organizations, including ASTM, U.S. Government Federal Specifications (TT-P; MIL-P, etc.), Federal Test Method Standards (141), and Canadian Government Specifications Board. A partial listing of public zinc-rich specifications requiring qualification testing is presented in the Notes of SSPC-PS Guide 12.00, "Guide for Selecting Zinc-Rich Painting Systems."

However, it should be emphasized that a well designed non-standard test may often provide more meaningful information for a given service condition than one or more standard tests.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 21
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 21

## White or Colored Silicone Alkyd Paint
## Type I, High Gloss
## Type II, Medium Gloss

## 1. Scope

**1.1** This specification covers white or colored silicone alkyd paint suitable for the finish coat on primed structural steel.

**1.2 INTENDED USE:** The specification covers a high grade air dry silicone alkyd type copolymer gloss and medium gloss enamels intended for use on primed metal but particularly on smooth exterior metal. It is highly weather resistant and is characterized by excellent color and gloss retention. This coating is primarily intended for spray application, but may also be applied by brush or roller. It is to be applied in accordance with SSPC-PA 1, "Shop, Field and Maintenance Painting of Steel."

**1.3** The color of the enamel specified in the procurement documents shall match that of the standard color chip in FED-STD 595 or other colors agreed upon.

## 2. Description

**2.1** Two types of paint are available under this specification: Type I covers high gloss and Type II covers medium gloss silicone alkyd white or colored paints. Twelve colors are described under each type in this specification (see Tables 1 and 2).

**2.2** This paint contains a minimum of 60 to 67% by volume of nonvolatile film-forming solids (pigment and binder). The minimum theoretical spreading rate for a 1.5 mil (38 micrometers) dry film thickness is 640 to 720 square feet/U.S. gallon (15.7 to 17.6 square meters/liter). Actual spreading rates can be significantly lower.

## 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

**3.3** If there is a conflict between the requirements of any of the cited references and this specification, the requirements of this specification shall prevail.

**3.4 SSPC STANDARD:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 93** | Test Methods for Flash Point by Pensky-Martens Closed Tester |
| **D 95** | Test Method for Water in Petroleum Products and Bituminous Materials by Distillation |
| **D 185** | Test Method for Coarse Particles in Pigments, Pastes, and Paints |
| **D 235** | Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent) |
| **D 476** | Specification for Titanium Dioxide Pigments |
| **D 523** | Test Method for Specular Gloss |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 600** | Specification for Liquid Paint Dryers |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 1306** | Test Method for Phthalic Anhydride Content of Alkyd Resins and Esters Containing Other Dibasic Acids (Gravimetric) |
| **D 1398** | Test Method for Fatty Acid Content of Alkyd Resins and Alkyd Resin Solutions |
| **D 1640** | Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature |
| **D 1729** | Practice for Visual Evaluation of Color Differences of Opaque Materials |
| **D 1849** | Test Method for Package Stability of Paint |
| **D 2244** | Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates |
| **D 2369** | Test Method for Volatile Content of Coatings |

Provided by : www.spic.ir Licensee: NISOC Library

**D 2371** Test Method for Pigment Content of Solvent-Reducible Coatings
**D 2698** Test Method for the Determination of Pigment Content of Solvent Reducible Paints by High Speed Centrifuging
**D 2800** Test Method for Preparation of Methyl Esters from Oils for Determination of Fatty Acid Composition by Gas-Liquid Chromatography
**D 2805** Test Method for Hiding Power of Paints by Reflectometry
**D 3335** Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
**D 5486** Specification for Pressure-Sensitive Tape for Packaging, Box Closure, and Sealing
**E 97** (Canceled) Test Method for Directional Reflectance Factor, 45°-0° of Opaque Specimens by Broad-Band Filter Reflectometry

**3.6 FEDERAL STANDARDS:**

**TT-E-1593** Enamel, Silicone Alkyd Copolymer, Gloss (for Exterior and Interior Use)

**FED-STD-141:** Paint, Varnish, Lacquer, and Related Materials: Methods of Inspection, Sampling, and Testing
**Section 9** Routine and Referee Testing Conditions
**Method 2011** Preparation of Steel Panels
**Method 3021** Condition in Container
**Method 4061** Skinning (Partially Filled Container)
**Method 4092** Coarse Particles and Skins in Synthetic Vehicle Enamels, Lacquers, and Dopes
**Method 4023** Reducibility and Dilution Stability
**Method 4321** Brushing Properties
**Method 4331** Spraying Properties
**Method 6221** Flexibility
**Method 7014** Analysis of Unsaponifiable Matter, Oil Acids, and Phthalic Anhydride in Alkyd Vehicles
**FED-STD-595:** Colors Used in Government Procurement

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

**Z129.1** Hazardous Industrial Chemicals – Precautionary Labeling

**TABLE 1**
**PIGMENTATION (TYPE I)**

| FED-STD-595 | COLOR DESIGNATION | PIGMENTATION |
|---|---|---|
| 10045 | Dark Brown | Titanium dioxide, red iron oxide, yellow iron oxide carbon or lampblack |
| 10049 | Maroon | Titanium dioxide, red iron oxide, yellow iron oxide, carbon or lampblack |
| 10324 | Light Brown | Titanium dioxide, red iron oxide, yellow iron oxide, carbon or lampblack |
| 11105 | Red[1] | Quinacridone violet, light stable molybdate orange |
| 12197 | Int. Orange[1] | Light stable molybdate orange |
| 13538 | Yellow[1] | Titanium dioxide, light stable chrome yellow |
| 14110 | Dark Green | Chrome oxide green, phthalocyanine green, yellow iron oxide |
| 14325 | Light Green | Titanium dioxide, phthalocyanine green |
| 15177 | Light Blue | Titanium dioxide, phthalocyanine blue, red iron oxide, carbon black or lampblack |
| 16187 | Medium Gray[1] | Titanium dioxide, yellow iron oxide, chrome yellow, phthalocyanine blue, carbon black, or lampblack |
| 17038 | Black | Carbon black, iron blue |
| 17886 | White | Titanium dioxide |
| Other Colors[2] | | |

[1] These enamels may contain lead when analyzed in accordance with ASTM D 3335. Such enamels shall not be used in dwellings, household equipment, toys, etc. The supplier shall furnish proper labeling and description of intended use for such enamels on every container.
[2] For additional colors refer to TT-E-1593.

Provided by : www.spic.ir Licensee: NISOC Library

## 4. Composition

**4.1** The pigments listed in Table 1 (or Type I) or Table 2 (or Type II), or any combination thereof, shall make up the basic pigmentation for the color specified. Extender pigments, shading pigments, and titanium dioxide conforming to ASTM D 476, Type IV, may be used when necessary to match the color specified, provided the enamel complies with the requirements of this specification.

**4.2** The vehicle shall consist of silicone-modified medium oil soya alkyd copolymer of the air-drying type, together with suitable thinners, driers, anti-skinning agents, wetting agents, dispersing agents, and stabilizers combined, producing a material conforming to all requirements specified herein. The silicone intermediate used in the preparation of the copolymerized resin shall be hydroxy functional. The vehicle shall conform to the composition (analysis) requirements of Table 3.

**4.3 SOLVENT:** Shall be mineral spirits conforming to ASTM D 235.

**4.4 DRIERS:** Shall conform to ASTM D 600.

## 5. Properties

**5.1** The paint shall meet the requirements of Table 6 and Sections 5.2 through 5.12.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296). The odor of the wet enamel and of the film at any interval of drying shall not be obnoxious or objectionable.

**5.3 COLOR:** Draw down a coat of enamel on a white opaque glass panel using a doctor blade with a 6 mil (150 micrometer) gap clearance designed to deposit a wet film thickness of approximately 3 mils (76 micrometers). After 48 hours drying, at 70 to 75 °F (21 to 24 °C) and 50% relative humidity, compare the dried film with the standard chip (FED-STD-595) or other color agreed upon in accordance with ASTM D 1729 for compliance. If doubt exists as to the color match, an instrumental referee method may be used (ASTM D 2244).

**5.4 DILUTION STABILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when one volume of the paint is slowly mixed with one

**TABLE 2**
**PIGMENTATION (TYPE II)**

| FED-STD-595 | COLOR DESIGNATION | PIGMENTATION |
|---|---|---|
| 27886 | White | Titanium dioxide |
| 26270 | Gray | Titanium dioxide, lampblack, or carbon black |
| 27038 | Black | Carbon black or lampblack |
| 20313 | Light Brown | Titanium dioxide, yellow iron oxide, and red iron oxide |
| 20045 | Dark Brown | Red iron oxide, yellow iron oxide, lampblack, or carbon black |
| 20062 | Maroon | Red iron oxide and lampblack or carbon black |
| 23655 | Yellow | Sun Yellow N |
| 22246 | Orange[1] | Molybdate orange |
| 21105 | Red[1] | Molybdate red or a blend of monastral violet and molybdate orange |
| 24325 | Aqua | Titanium dioxide, copper phthalocyanine green, yellow iron oxide, carbon black, or lampblack |
| 25177 | Blue | Titanium dioxide, copper phthalocyanine blue, lampblack, or carbon black |
| 24108 | Dark Green | Chrome oxide green, copper phthalocyanine green |

[1] These enamels may contain lead when analyzed in accordance with ASTM D 3335. Such enamels shall not be used in dwellings, household equipment, toys, etc. The supplier shall furnish proper labeling and description of intended use for such enamels on every container.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 3**
**VEHICLE CHARACTERISTICS**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Copolymer resin solids, percent by weight of extracted vehicle solids[1] | 50.0 | --- | --- | --- |
| Silica ($SiO_2$), percent by weight of copolymer resin solids[2] | 14.0 | --- | --- | --- |
| Phthalic anhydride, percent by weight of copolymer resin solids | 14.0 | 17.0 | D 1306 | 7014[3] |
| Soya oil acid content (based on solids) | 41.0 | 55.0 | D 1398 | 7014[3] |
| Soya oil | Positive | --- | D 2800 | --- |

[1] Copolymer resin content of nonvolatile isopropanol extraction: Weigh five grams (to the nearest 0.1 mg) of vehicle into a tared centrifuge bottle or tube fitted with a cap. Add 50 ml of isopropanol (technical grade), cap the bottle or tube, and shake vigorously for two minutes. Centrifuge for 15 minutes at a minimum of 2,000 rpm. Decant the isopropanol extract and repeat the extraction and condition the bottle or tube in a 135 °C oven for three hours. Remove the bottle or tube, cool for 30 minutes at room temperature, and weigh. Calculate the copolymer resin solids using the following formula:

$$\text{Percent copolymer resin solids} = \frac{R \times 100}{S \times D}$$

Where:
R = Weight of residue (in the bottle or tube)
S = Weight of sample
D = Percent of vehicle solids (see Note 4, Tables 4 and 5)

[2] Silica Content of Vehicle: From a stoppered bottle or weighing pipet, weigh accurately by difference, about 3 grams of the vehicle into a properly ignited and weighed 3-inch porcelain evaporating dish. Dry at 105 °C in an oven for 3 hours. Place the dried sample in a cold muffle furnace and gradually increase the temperature over a period of 3 hours to 800 °C. Then maintain this temperature for an additional hour. After cooling in a desiccator, weigh the dish and contents and calculate the percent of silica as follows:

$$\text{Percent Silica} = \frac{A \times 100}{S \times D}$$

Where:
A = Weight of ash
S = Weight of sample (vehicle)
D = Percent of vehicle solids (see Note 4, Tables 4 and 5)

[3] Altered by the substitution of petroleum ether for chloroform.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 4**
**SPECIFIC QUANTITATIVE REQUIREMENTS (TYPE I)**
**Percent by Weight of Enamel**

| FED-STD-595 | DESIGNATION | TOTAL SOLIDS[3] Minimum | PIGMENT SOLIDS[2] Min. | PIGMENT SOLIDS[2] Max. | VEHICLE SOLIDS[4] Minimum |
|---|---|---|---|---|---|
| 10045 | Dark Brown | 57 | 11 | 15 | 45 |
| 10049 | Maroon | 57 | 13 | 16 | 42 |
| 10324 | Light Brown | 61 | 23 | 27 | 37 |
| 11105 | Red | 53 | 11 | 15 | 40 |
| 12197 | Int. Orange | 62 | 24 | 27 | 36 |
| 13538 | Yellow | 66 | 33 | 37 | 31 |
| 14110 | Dark Green | 58 | 15 | 19 | 42 |
| 14325 | Light Green | 60 | 21 | 25 | 38 |
| 15177 | Light Blue | 60 | 21 | 25 | 38 |
| 16187 | Medium Gray | 59 | 21 | 25 | 36 |
| 17038 | Black | 50 | 2 | 5 | 48 |
| 17886 | White | 64 | 31 | 35 | 37 |

[1] For additional colors refer to TT-E-1593.
[2] Use ASTM D 2371. These are not specific quantitative requirements but suggested guidelines only.
[3] Use ASTM D 2369.
[4] Vehicle Solids: Place a portion (approximately 10 grams) of the vehicle (separated as in ASTM D 2698) in a dropping bottle and weigh to the nearest 0.1 mg. Weigh one of the 60 mm aluminum dishes with fourth-decimal place accuracy. Transfer a small sample that does not exceed 0.3 grams to the dish, and determine its exact weight by loss of weight of the bottle. Dissolve the sample in 2 ml of ACS reagent grade toluene and dry in a gravity convection oven at 105 ± 2°C for three hours. After cooling for 30 minutes, weigh the dish to the nearest 0.1 mg. From the weight of the residue in the dish and the weight of the sample taken, calculate the percent vehicle solids.

volume of mineral spirits (FED-STD-141, Method 4203). However, slight pigment settling shall be permitted.

**5.5 BRUSHING PROPERTIES:** The enamel, as packaged, shall be easily applied when tested in accordance with FED-STD-141, Method 4321. The enamel shall dry to a smooth, uniform film, free from seeds, runs, sags, or streaks. The dried film shall show no discernible brush marks.

**5.6 SPRAYING PROPERTIES:** Prepare a steel panel in accordance with FED-STD-141, Method 2011 using the petroleum naptha ethylene glycol monoethyl ether mixture. Spray apply the enamel to this panel to a dry film thickness of 0.9 to 1.1 mils (23 to 28 micrometers). The enamel shall be easily applied when tested in accordance with FED-STD-141, Method 4331. The enamel shall show no running, sagging, or streaking. The air dried film shall show no seeding, dusting, floating, fogging, mottling, hazing, excessive orange peel, or other film defects.

**5.7 CONDITION IN CONTAINER:** Determine package condition of the enamel in accordance with FED-STD-141, Method 3011. The enamel shall be free of grit, seeds, skins, lumps, thickening, or livering and shall show no more pigment settling or caking that can be readily reincorporated to a smooth homogeneous state. Reseal and then agitate the can for three minutes on a paint shaker. On reexamination of the contents, the disclosure of gel bodies, undispersed pigment, or unsatisfactory settling properties is cause for rejection.

**5.8 STORAGE STABILITY, PARTIALLY FULL CONTAINER:** Determine skinning after 48 hours in accordance with FED-STD-141, Method 3021 except use 3/4 filled, 1/2 pint (250 ml) multiple friction top can. The enamel shall show no skinning. Reseal and store for seven days at 140 °F (60 °C) and observe. The enamel shall show no livering, curdling, hard caking, or gummy sediment. It shall mix readily to a smooth homogeneous state.

**5.9 STORAGE STABILITY, FULL CONTAINER:** Determine the storage stability of the package enamel in accordance with ASTM D 1849 using a standard quart can allowed to stand undisturbed for 12 months. The enamel shall show no skinning, livering, curdling, hard-dry caking, or tough gummy sediment. Evaluate pigment settling or caking, but agitate the can for five minutes on the paint shaker prior to examination. The enamel shall mix readily to a smooth homogeneous state and must be usable. The consistency of the enamel after storage shall be 60 to 82 Krebs units (ASTM D 562).

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 5**
**SPECIFIC QUANTITATIVE REQUIREMENTS (TYPE II)**
**Percent by Weight of Enamel**

| | | TOTAL SOLIDS[2] | PIGMENT SOLIDS[1] | | | VEHICLE SOLIDS[3] |
|---|---|---|---|---|---|---|
| | | | HIDING | | EXTENDER | |
| FED-STD-595 | DESIGNATION | Minimum | Min. | Max. | Maximum | Minimum |
| 27886 | White | 65 | 24 | 28 | 20 | 25 |
| 26270 | Gray | 63 | 14 | 18 | 24 | 26 |
| 27038 | Black | 60 | 2 | 4 | 25 | 32 |
| 20313 | Light Brown | 65 | 19 | 23 | 24 | 25 |
| 20045 | Dark Brown | 62 | 7 | 11 | 28 | 29 |
| 20062 | Maroon | 63 | 7 | 11 | 28 | 29 |
| 23655 | Yellow | 67 | 28 | 32 | 17 | 23 |
| 22246 | Orange | 65 | 19 | 23 | 24 | 25 |
| 21105 | Red | 64 | 12 | 16 | 26 | 30 |
| 24325 | Aqua | 64 | 17 | 21 | 24 | 26 |
| 25177 | Blue | 67 | 16 | 20 | 24 | 26 |
| 24108 | Dark Green | 62 | 15 | 19 | 28 | 28 |

[1] Use ASTM D 2371. These are not specific quantitative requirements but suggested guidelines only.

[2] Use ASTM D 2369.

[3] Vehicle Solids: Place a portion (approximately 10 grams) of the vehicle (separated as in ASTM D 2698) in a dropping bottle and weigh to the nearest 0.1 mg. Weigh one of the 60 mm aluminum dishes with fourth-decimal place accuracy. Transfer a small sample that does not exceed 0.3 grams to the dish, and determine its exact weight by loss of weight of the bottle. Dissolve the sample in 2 ml of ACS reagent grade toluene and dry in a gravity convection oven at 105 ± 2°C for three hours. After cooling for 30 minutes, weigh the dish to the nearest 0.1 mg. From the weight of the residue in the dish and the weight of the sample taken, calculate the percent vehicle solids.

**5.10 ADHESION:** Use the panel prepared in 5.6 by air drying for 18 hours, then baking for 2 hours at 220 ± 4 °F (105 ± 2 °C). Condition the panel for one hour under referee testing conditions (Section 9 of FED-STD-141), then score a line through to the metal across the width of the film using a sharp pointed knife. The film shall then be taped perpendicular to and across the score line with waterproof, pressure sensitive tape, 3/4 inch (2 cm) wide, conforming to ASTM D 5486. Press the tape in firm contact with pressure. Allow approximately 10 seconds for the test area to return to room temperature. Grasp the free end of the tape and at a rapid speed strip it from the film by pulling back from the panel at an approximately 180 degree angle. The enamel shall show no removal of the film or loosening beyond 1/16 inch (2 mm) on either side of the score line.

**5.11 FLEXIBILITY:** Determine flexibility in accordance with FED-STD-141, Method 6221. Apply a 2 inch (5 cm) wide film of enamel on a smooth finish steel panel, prepared in accordance with FED-STD-141, Method 2011, using the petroleum naphtha ethylene glycol monoethyl ether mixture with a suitable film applicator that will give a dry film thickness of 0.9 to 1.1 mils (28 to 28 micrometers). The panel shall be prepared for new cold rolled rust-free carbon steel 10 ± 1 mils (250 ± 25 micrometers) thick with a Rockwell 15-T maximum hardness of 82 and a finish with surface toughness of 8 to 12 microinches (0.2 to 0.3 micrometers). Air dry in a horizontal position for 18 hours, and then bake for 168 hours at 220 ± 4 °F (105 ± 2 °C). Condition the panel for 1/2 hour under standard testing conditions (see Section 9 of FED-STD-141). Bend over a 1/4 inch (6 mm) mandrel. Examine the coating for cracks over the area of the bend in a strong light at seven diameters magnification. The enamel shall withstand the bending without cracking or flaking.

**5.12 HIDING POWER (CONTRAST RATIO):** Determine the hiding power in accordance with ASTM D 2805. Draw down a film using an applicator that will deposit a dry film of 1 mil (25 micrometers) maximum thickness. Air dry for 72 hours, measure the thickness of the dry film, then measure the reflectance. Calculate the contrast ratio. A dry film thickness of 1 mil (25 micrometers) maximum of white enamel (minimum reflectance 84%) shall give a dry film contrast ratio of 0.95. The minimum dry film contrast ratio for tints applied at the same wet film thickness in terms of apparent reflectivity shall be specified in Table 7.

## 6. Labeling

**6.1** Refer to ANSI Z129.1 Other guidelines can be found in the National Paint and Coatings Association (NPCA) "Paint Industry Labeling Guide."

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 6**
**QUANTITATIVE REQUIREMENTS OF THE ENAMEL**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Flash Point, Pensky-Martens, closed cup, °C | 30 | --- | D 93 | --- |
| Water, percent by weight of enamel | --- | 0.5 | D 95 | --- |
| Coarse particles and skins (retained on No. 325 mesh sieve), percent by weight of pigment | --- | 0.1 | D 185 | 4092 |
| Gloss, 60° specular | | | | |
| Type I enamel | 87 | --- | D 523 | --- |
| Type II enamel | 40 | --- | D 523 | --- |
| Gloss, 20° specular | | | | |
| Type I enamel | 70 | --- | D 523 | --- |
| Viscosity*, shear rate 200 rpm | | | | |
| Grams | 125 | 175 | D 562 | --- |
| Krebs Units | 67 | 77.0 | D 562 | --- |
| Fineness of Grind | | | | |
| Type I enamel | 7 | --- | D 1210 | --- |
| Type II enamel | 6 | --- | D 1210 | --- |
| Daylight 45°, 0° directional reflectance | | | | |
| Type I white enamel | 87 | --- | E 97 | --- |
| Type II white enamel | 84 | --- | E 97 | --- |
| Drying time: | | | | |
| Set to touch, hours | --- | 2 | D 1640 | 4061 |
| Dry hard, hours | --- | 8 | D 1640 | 4061 |

*Viscosity 48 hours or more after manufacture

**6.2 MARKING OF CONTAINERS:** Each container shall be legibly marked with the following information:

Name: White or Colored Silicone Alkyd Paint
Specification: SSPC-Paint 21, Type
Color:
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of White or Colored Silicone Alkyd Paint

This paint is intended for use as a finish coat over a rust inhibitive primer (or other suitable primers) and an intermediate coat on structural steel. Before applying, remove all moisture, oil, grease, dirt, and loose or nonadhering paint. Sound old coatings that are compatible with this silicone alkyd paint may remain, but damaged areas or areas of poor adhesion must be spot-cleaned and spot-primed.

Mix paint thoroughly before use. If simple stirring is inadequate, pour off most of the liquid into a clean container. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring contents to a larger container or by pouring the paint to and from another container. Examine the bottom of the container for unmixed pigment. Screen paint before applying.

Thin paint only if necessary, using only mineral spirits. For brush application under normal conditions, no thinning should be necessary. For spray applications, add up to one pint of thinner per gallon (130 ml/L) of unthinned paint when necessary.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 1.5 mils (38 micrometers) dry or approximately 2.5 mils (64 micrometers) wet. The surface to be painted shall be dry; the surface temperature shall be at least 5 °F (3 °C) above the dew point; and the temperature of the air shall be over 40 °F (4 °C). Do not paint outdoors in rainy weather or if freezing temperatures are expected before the paint dries.

Allow paint at least 24 hours drying time in good weather before recoating.

Provided by : www.spic.ir Licensee: NISOC Library

**Table 7**
**MINIMUM DRY FILM CONTRAST RATIO FOR TINTS**

| Apparent Reflectivity of Tint (percent) | Contrast Ratio |
|---|---|
| 82 | 0.94 |
| 80 | 0.94 |
| 78 | 0.95 |
| 76 | 0.95 |
| 74 | 0.96 |
| 72 | 0.96 |
| 70 | 0.97 |
| 68 | 0.97 |
| 66 | 0.98 |
| 64 | 0.98 |
| 62 | 0.98 |
| 60 or Below | 0.98 |

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedures established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure used by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 22
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 22

## Epoxy Polyamide Paints (Primer, Intermediate, and Topcoat)

### 1. Scope

**1.1** This specification covers three types of two-component epoxy polyamide coatings—primer, intermediate, and topcoat—for use on steel surfaces. The information described herein shall be used as a control for evaluation of proposed coating systems. See SSPC-PS 13.01, "Epoxy Polyamide Painting System," for specifications covering system requirements, including surface preparation, application, and thickness.

**1.2** These coatings, when applied over properly prepared steel surfaces, are suitable for exposures in environmental zones 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 3A (chemical, acidic), 3B (chemical, neutral), 3C (chemical, alkaline), 3D (chemical, solvents); but not for potable water tanks. They are intended for brush or spray application over steel prepared in accordance with SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 8, "Pickling." The performance will be improved by a better degree of surface preparation. They are suitable for shop, field, or maintenance coatings and are to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel." If the primed part of the structure is to be exposed to the weather, it should be topcoated as soon as practical.

### 2. Description

**2.1** The coatings supplied under this specification are two-part products composed of a base component and a curing agent component. When the two components are mixed in the proper proportions the coatings are capable of curing at temperatures as low as 50°F (10°C) and fully curing in seven days.

**2.2** The primer contains approximately 65% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 2.5 mil (63 micrometers) dry film thickness is 420 square feet/U.S. gallon (10.2 square meters/liter).

**2.3** The intermediate contains approximately 65% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 2.5 mil (64 micrometers) dry film thickness is 420 square feet/U.S. gallon (10.2 square meters/liter).

**2.4** The topcoat contains approximately 60% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for 2.5 mil (63 micrometers) dry film thickness is 380 square feet/U.S. gallon (9.5 square meters/liter).

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |
| **PS 13.01** | Epoxy Polyamide Painting System |
| **VIS 2** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **B 117** | Method of Salt Spray (Fog) Testing |
| **D 209** | Specification for Lampblack Pigment |
| **D 263** | Specification for Chrome Oxide Green Pigment |
| **D 331** | Specification for 2-Ethoxyethyl Acetate (95% Grade) |
| **D 476** | Specification for Titanium Dioxide Pigments |
| **D 522** | Test Methods for Mandrel Bend Test of Attached Organic Coatings |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 605** | Specification for Magnesium Silicate Pigment (Talc) |
| **D 607** | Specification for Wet Ground Mica Pigments |
| **D 610** | Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces |
| **D 714** | Test Method for Evaluating Degree of Blistering of Paints |
| **D 1153** | Specification for Methyl Isobutyl Ketone |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1310** | Test Method for Flash Point and Fire Point of Liquids by Tag Open-Cup Apparatus |
| **D 1475** | Test Method for Density of Paint, Varhish, Lacquer, and Related Products |
| **D 1544** | Test Method for Color of Transparent Liquids by Bubble Time Method |
| **D 1640** | Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature |
| **D 1648** | Specification for Basic Lead Silicochromate Pigment |
| **D 1652** | Test Methods for Epoxy Content of Epoxy Resins |
| **D 1654** | Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 3722** | Specification for Natural Red and Brown Iron Oxide Pigments |

**3.6 FEDERAL STANDARDS:**

| | |
|---|---|
| **MIL-DTL-24441** | Paint, Epoxy Polyamide, General Specification for |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals – Precautionary Labeling |

## 4. Composition

**4.1** Ingredients and proportions of the reference formulations shall be as specified in Table 1.

**4.2** Each component of these paints based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles.

**4.3** The base component of each coating shall contain an epoxy resin together with anti-corrosion pigments, color pigments, mineral fillers, gellant, leveling agent, and volatile solvents. The epoxy resin shall be a di-epoxide condensation product of biphenol A and epichlorohydrin with terminal epoxide group.

**4.4** The curing agent component of each coating shall contain a liquid type polyamide resin and volatile solvent. The polyamide resin shall be a condensation product of dimerized fatty acids and polyamines.

**4.5** Each coating shall conform to the composition (analysis) requirements of Table 2.

## 5. Properties

**5.1** The epoxy resin shall meet the requirements of Table 3.

**5.2** The undiluted polyamide resin shall meet the requirements of Table 4.

**5.3** Coatings supplied under this specification shall be comparable in performance to the reference formulations of Table 1. They need not be composed of the quantities and types of ingredients given in Table 1. However, if substitutions of other ingredients are made, the coatings shall meet the performance requirements of this specification; and, when incorporated into a painting system, the performance requirements of SSPC-PS 13.01, "Epoxy Polyamide Painting System."

**5.4** After combining the base and curing agent components, the primer, intermediate, and topcoat shall conform to the requirements of Table 5 and Sections 5.5 through 5.9.

**5.5 POT LIFE:** Determine pot life of the individual coatings as follows. Thoroughly mix a one-pint sample of the finished coating and let stand at 77 ± 3°F (25 ± 2°C) for eight hours. At the end of this time there shall be no evidence of gelation. The coatings shall be in a free-flowing condition and brushable without thinning. NOTE: When mixing larger volumes, more heat will develop with a resultant shortening of the pot life.

**5.6 SOLVENT RESISTANCE:** The development of solvent (methyl ethyl ketone) resistance is required as an indication of satisfactory cure and subsequent chemical resistance. Apply the individual coating (primer, intermediate, topcoat) by spray or brush to a clean test panel so that a dry film thickness of two to three mils (51- 76 micrometers) per coat is obtained. Air dry the panel for five days at 77 ± 3°F (25 ± 2°C) and relative humidity of 40%- 50%. Following the curing period, saturate a small cottonball with methyl ethyl ketone and place on the test panel under a

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**COMPOSITION OF REFERENCE FORMULATIONS**

| INGREDIENTS | PRIMER Lb. | (kg) | Gals. | (L) | INTERMEDIATE Lb. | (kg) | Gals. | (L) | TOPCOAT Lb. | (kg) | Gals. | (L) | STANDARDS ASTM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BASE COMPONENT: | | | | | | | | | | | | | |
| Red Iron Oxide | 17 | (7.7) | 0.46 | (1.7) | 68 | (30.9) | 1.83 | (6.9) | — | — | — | (12.5) | D 3722 |
| Rutile Titanium Dioxide | — | | — | | — | | — | | 115 | (52.2) | 3.29 | (5.5) | D 476 |
| Magnesium Silicate | 85 | (38.6) | 3.58 | (13.6) | 68 | (30.9) | 2.86 | (10.8) | 55 | (25.0) | 2.32 | (8.8) | D 263 |
| Mica | 28 | (12.7) | 1.19 | (4.5) | 23 | (10.4) | 0.98 | (3.7) | 18 | (8.2) | 0.77 | (2.9) | D 605 |
| Lampblack | — | | — | | — | | — | | 2 | (0.9) | 0.13 | (0.5) | D 607 |
| Organo Montmorillonite[1] | 8 | (3.6) | 0.56 | (2.1) | 8 | (3.6) | 0.56 | (2.1) | 8 | (3.6) | 0.56 | (2.1) | D 209 |
| 95/5 Methanol/Water | 3 | (1.4) | 0.40 | (1.5) | 3 | (1.4) | 0.40 | (1.5) | 3 | (1.4) | 0.40 | (1.5) | — |
| Epoxy Resin[2] | 199 | (90.3) | 20.10 | (76.1) | 201 | (91.3) | 20.30 | (76.9) | 212 | (96.2) | 21.41 | (81.1) | — |
| Leveling Agent[3] | 10 | (4.5) | 1.18 | (4.5) | 10 | (4.5) | 1.18 | (4.5) | 11 | (5.0) | 1.29 | (4.9) | — |
| Methyl Isobutyl Ketone | 43 | (19.5) | 6.44 | (24.4) | 44 | (20.0) | 6.59 | (25.0) | 46 | (20.9) | 6.89 | (26.1) | — |
| Xylene | 126 | (57.2) | 17.36 | (65.7) | 150 | (68.1) | 20.64 | (78.1) | 111 | (50.4) | 15.28 | (57.8) | D 1153 |
| 2-Ethoxy Ethanol | 67 | (30.4) | 8.66 | (32.8) | 65 | (29.5) | 8.40 | (31.8) | 69 | (31.3) | 8.91 | (33.7) | D 364 |
| TOTALS (Base Component) | 586 | (266) | 59.93 | (226.9) | 640 | (290.6) | 63.70 | (241.3) | 713 | (324.7) | 62.70 | (237.4) | D 331 |
| CURING AGENT COMPONENT: | | | | | | | | | | | | | |
| Polyamide Resin[4] | 107 | (48.6) | 13.20 | (50.0) | 108 | (49.0) | 13.33 | (50.5) | 114 | (51.0) | 14.07 | (53.3) | — |
| Xylene | 104 | (47.2) | 14.32 | (54.2) | 109 | (49.5) | 15.02 | (56.7) | 142 | (64.5) | 19.56 | (74.0) | — |
| TOTALS (Curing Agent Comp.) | 211 | (95.8) | 27.52 | (104.2) | 217 | (98.5) | 28.35 | (107.2) | 256 | (116.3) | 33.63 | (127.3) | |
| TOTALS (Formulation) | 797 | (361.7) | 87.45 | (331.0) | 857 | (389.1) | 92.09 | (348.5) | 969 | (440.0) | 96.30 | (364.7) | |

[1] NL Industries Bentone 27 or equivalent
[2] Epon Resin 1001, Shell Chemical Company or equivalent
[3] Beetle 216-8, American Cyanamid Company or equivalent
[4] Versamid 115 (Henkel), Uni-Rez 2115 (Union Camp) or equivalent

**TABLE 2**
**ANALYSIS**

| CHARACTERISTICS | PRIMER Min. | Max. | INTERMEDIATE Min. | Max. | TOPCOAT Min. | Max. | STANDARDS ASTM |
|---|---|---|---|---|---|---|---|
| Nonvolatiles, % by weight | 65 | — | 65 | — | 60 | — | D 2369 |

**TABLE 3**
**EPOXY RESIN ANALYSIS**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM |
|---|---|---|---|
| Epoxide Equivalent | 450 | 550 | D 1652 |
| Color, Gardner (40% in Butyl Carbitol) | — | 4 | D 1544 |

**TABLE 4**
**POLYAMIDE RESIN ANALYSIS**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM |
|---|---|---|---|
| Amine Value[1] | 230 | 250 | — |
| Color, Gardner | — | 8 | D 1544 |
| Specific Gravity | 0.96 | 0.98 | D 1475 |
| Viscosity, Brookfield, at 75%°C, poises | 31 | 37 | — |

[1] Perchloric acid titration

Provided by : www.spic.ir Licensee: NISOC Library

watch glass for 30 minutes. After a ten-minute recovery period, determine the pencil hardness of the coating. The minimum allowable rating is "7B."

Determine pencil hardness as follows: Using a series of drawing leads (either wood clinched or secured in a mechanical holder), expose approximately 1/4" (6 mm) of lead. With a rotary motion square the point of the lead against No. 400 grit paper. Hold the lead at approximately 45° and push forward against the film using a pressure just short of breaking the lead. If penetration is not made, repeat using the next harder lead until penetration is made. Rate the film by indicating the hardest lead that does not penetrate.

**5.7 TEST PANELS:** Test panels shall be carbon steel—minimum size 4" x 8" x 1/8" (10.2 x 20.3 x 0.31 cm)—unless otherwise specified. They shall be blast cleaned in accordance with SSPC-SP 10, "Near-White Blast Cleaning." Air drying and test conditions shall be at 77 ± 3°F (25 ± 2°C), and 40%-50% relative humidity.

**5.8 ELCOMETER ADHESION TEST:** Prepare test panels as in Section 5.7 using 1 /4" (6 mm) thick steel plate. Apply coatings at 2.0-3.0 mils (51-76 micrometers) dry film thickness per coat in accordance with the following schedule.

| COATING | SUBSTRATE | DRYING TIMES |
|---|---|---|
| Primer | Steel | Five days |
| Intermediate | Primer | 72 hours for primer |
| | | 72 hours for intermediate |
| Topcoat | Primer and | 72 hours for primer |
| | Intermediate | 72 hours for intermediate |
| | | 5 days for topcoat |

The adhesion of the prime coat to the substrate, intercoat adhesion, or cohesion of any coat of the painting system shall be determined by the adhesion tester (1,000 pounds, 156 kg). Prepare test panels as described above. Lightly sand the coating surface and aluminum dolly, and apply a quick set adhesive containing alpha cyanoacrylate. Allow the adhesive to cure overnight. Scribe the coating and adhesive around the dolly prior to testing. Make a minimum of three trials and report the average. An average of 400 pounds per square inch (280,000 kg/square meter) is considered acceptable.

**5.9 SALT SPRAY RESISTANCE (PRIMER ONLY):** Prepare at least two test panels as in Section 5.7 and apply one prime coat at 2.5-3.0 mils (64 to 76 micrometers) dry film thickness. Air dry five days. Protect the backs and edges. Scribe the panels as per ASTM D 1654 to base metal and exposure for 500 hours at five percent salt spray in accordance with ASTM B 117. During the test, the panels shall be inclined at an angle of 15 degrees off the vertical. At the end of the test period, the primer shall have a minimum rust grade rating of "8." Blistering shall be no more than Blister Size No. 4, few. Photographic standards SSPC-VIS 2, "Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces," or ASTM D 610 may be used for rusting, and ASTM D 714 may be used for blistering.

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals — Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container of each component shall be legibly marked with the following information:

Name: Epoxy Polyamide Coating (Specify Which: Primer, Intermediate, or Topcoat)
Specification: SSPC-Paint 22
Component:
Color:
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The manufacturer shall supply complete instructions covering uses, surface preparation, mixing, thinning, application method, application conditions, pot life, wet and dry film thicknesses, temperature and humidity limitations, drying time, etc., with each container of paint.

**6.4** The following are guidelines for the instructions required:

Mixing and Thinning: Each coating component should be stirred to a smooth homogenous mixture. Then the proper amount of base and curing agent components, as recommended by the manufacturer, should be added together and mixed thoroughly. After allowing to stand for 30 minutes at 77 ± 3 °F (25 ± 2°C), the coating may be thinned up to 12% by volume of the total coating for spraying. The coating should be applied within the manufacturer's pot life limitations.

Coating Thickness: The coatings are usually applied by spray to a dry film thickness of two to three mils (51-76 micrometers) per coat with total dry thickness seven to nine mils (178-229 micrometers), as measured in accordance with SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages."

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 5**
**PROPERTIES**

| CHARACTERISTICS | PRIMER Min. | PRIMER Max. | INTERMEDIATE Min. | INTERMEDIATE Max. | TOPCOAT Min. | TOPCOAT Max. | STANDARDS ASTM |
|---|---|---|---|---|---|---|---|
| Viscosity shear rate 200 rpm Kreb Units | 65 | 85 | 60 | 80 | 60 | 80 | D 562 |
| Weight per U.S. Gallon, pounds (kg/L) | 11.7 (1.4) | 12.7 (1.5) | 11.0 (1.3) | 12.0 (1.4) | 9.7 (1.2) | 10.7 (1.3) | D 1475 |
| Fineness of grind, Hegman units | 3.0 | — | 3.0 | — | 3.0 | — | D 1210 |
| Drying time (75°F [25°C], 45% R.H.): | | | | | | | |
| Tack-free, hours | — | 2 | — | 2 | — | 2 | |
| Dry Hard, hours | — | 5 | — | 5 | — | 5 | |
| Dry Through, hours | — | 8 | — | 8 | — | 8 | |
| Flash Point, °F | 81 | — | 81 | — | 81 | — | D 1310 |

Cure Time Between Coats: Under normal conditions, each coat should be air dried a minimum of four hours, but no more than 72 hours between application coats. In very hot weather with surfaces exposed to direct sunlight, it may be necessary to limit the intercoat drying period to 24 hours or less. Long drying time between coats may cause poor intercoat adhesion. These coatings shall not be applied at temperatures below 50°F(10°C).

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 23

## Latex Primer for Steel Surfaces

### 1. Scope

**1.1** This specification covers an air drying, ready-mixed, water-borne primer for blast cleaned steel. It is intended for use as a primer coat of a water-borne coating system consisting of two coats of this primer and one or two coats of a water-borne topcoat.

**1.2** This primer is suitable for exposures in Environmental Zones 1A (interior, normally dry) and 1B (exterior, normally dry), and is intended for brush, spray, or roller application over steel surfaces prepared in accordance with SSPC-SP 6, "Commercial Blast Cleaning." It is suitable as a shop primer, field primer, maintenance primer, or intermediate coat and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel." It is not recommended to expose steel to the weather with less than two coats of water-borne coating; therefore, intermediate and topcoats should be applied as soon as possible.

### 2. Description

**2.1** This primer is based on a latex vehicle produced by emulsion polymerization and appropriate pigments. Details of the composition are given in Table 1.

**2.2** This primer contains approximately 36% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 2.0 mil (51 micrometers) dry film thickness is 290 square feet/U.S. gallon (7.1 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **Paint 24** | Latex Semigloss Exterior Topcoat |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **VIS 2** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **B 117** | Method of Salt Spray (Fog) Testing |
| **D 522** | Test Methods for Mandrel Bend Test of Attached Organic Coatings |
| **D 523** | Test Method for Specular Gloss |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 609** | Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products |
| **D 610** | Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces |
| **D 714** | Test Method for Evaluating Degree of Blistering of Paints |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 1640** | Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature |
| **D 1654** | Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments |
| **D 1737** | (Canceled) Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus (Replaced with ASTM D 522) |
| **D 1849** | Test Method for Package Stability of Paint |
| **D 2243** | Test Method for Freeze-Thaw Resistance of Water-Borne Coatings |
| **D 2247** | Practice for Testing Water Resistance of Coatings in 100% Relative Humidity |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **D 2486** | Test Method for Scrub Resistance of Interior Latex Flat Wall Paints |
| **D 2574** | Test Method for Resistance of Emulsion Paints in the Container to Attack by Microorganisms |
| **D 2801** | (Canceled) Test Method for Leveling Characteristics of Paints by Draw-Down Method (See ASTM D 4400.) |
| **D 3273** | Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber |
| **D 3274** | Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |
| **D 4400** | Test Method for Sag Resistance of Paints Using a Multinotch Applicator |

**3.6 FEDERAL STANDARDS:**

| | |
|---|---|
| **TT-E-506** | Enamel, Alkyd, Gloss, Tints and White (for Interior Use) |

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 2021** | Preparation of Glass Panels |
| **Method 6141** | Washability |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals—Precautionary Labeling |

## 4. Composition

**4.1** The manufacturer is given some latitude in the selection of materials and process of manufacture, provided that the primer meets the requirements of this specification. Materials shall be of the best quality used in good commercial practice and entirely suitable for the purpose intended under normal conditions of use.

**4.2** The vehicle shall be a stable dispersion of synthetic resin particles (latex) in water prepared by emulsion polymerization, together with the necessary additives such as pigment dispersant, antifoamer, preservatives, and "antifreeze" in order to produce a primer conforming to this specification. A suitable film and package preservative shall be used.

**4.3** The paint shall conform to the composition (analysis) requirements of Table 1.

## 5. Properties

**5.1** The paint shall meet the requirements of Table 2 and Sections 5.2 through 5.17.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296). In a freshly opened container, there shall be no offensive, disagreeable, or putrid odor.

**5.3 COLOR:** The color shall be as specified in the procurement documents.

**5.4 RESISTANCE TO MICROORGANISM ATTACK:** The paint shall be resistant to attack by microorganisms when tested according to ASTM D 2574.

**5.5 APPLICATION PROPERTIES:** The paint shall be easily applied to a smooth steel vertical surface at 4 mils (102 micrometers) wet film thickness on 400 square feet/gallon (9.8 square meters/liter) by brush, spray, or roller. Drying shall be done in a well-ventilated room or chamber free from drafts and dust in diffused light, not in direct sunlight. The temperature of the air shall be between 21 and 28°C. The relative humidity shall be 50% ± 5%. There shall be no runs, sags, streaks, flashes, laps, pinholing, eyeing, or cratering. After four hours of drying, apply a second coat in the same manner as the first. There shall be no picking-up or rolling-up of the first coat during applications. After 24 hours, the film shall be smooth and uniform.

**5.6 CONDITION IN CONTAINER:** The primer as received shall show no evidence of livering, skinning, or hard settling of the pigment. The inside of the container shall not be corroded. The material shall be easily dispersed in the liquid portion by hand stirring to form a smooth homogeneous paint. The primer shall show a minimum of foaming and be free of grit, seeds, lumps, or livering.

**5.7 FREEZE-THAW RESISTANCE:** The paint shall pass three cycles when tested according to the procedure described in ASTM D 2243. There shall be no gelation, or excessive thickening, coagulation, lumps, or coarse particles. The maximum allowable increase or decrease in viscosity shall not exceed 10 Kreb units.

**5.8 WET ADHESION:** Prepare 6" x 17"x 1/4"(15 cm x 43 cm x 0.63 cm) glass panels with a ground surface which has been cleaned according to FED-STD-141, Method 2021. Apply alkyd enamel conforming to Federal Specification TT-E-506 by drawndown with a suitable applicator to obtain a dry film thickness of 3.0 ± 0.3 mils (76 ± 8 micrometers) and a width of 5-1/2" (14 cm). Allow the alkyd

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**ANALYSIS**

| CHARACTERISTICS[1] | REQUIREMENTS Min. % | Max. % | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Pigment Volume Concentration | 22 | 35 | — | — |
| Nonvolatile Vehicle | 20 | — | — | — |
| Total Solids by Volume | 36 | — | — | — |
| Oil or Resin Modifiers in Nonvolatile Vehicle, wt. | — | 40 | — | — |

[1] Theoretical as calculated.

**TABLE 2**
**PROPERTIES**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Viscosity* shear rate 200 rpm | | | | |
| Grams | 150 | 240 | D 562 | — |
| Kreb units | 72 | 88 | D 562 | — |
| Fineness of grind, Hegman units | 3.0 | — | D 1210 | — |
| Drying time, hours | | | | |
| Dry to touch | — | 4 | D 1640 | — |
| Dry hard | — | 24 | D 1640 | — |
| 60 degrees Specular Gloss | — | 25 | D 523 | — |
| Sag Resistance, mils | 6 | — | D 2801** | — |

*Viscosity 48 hours or more after manufacture.
**ASTM D 2801 has been replaced by ASTM D 4400.

enamel to dry in a horizontal position for three days at 74-80°F (23-27°C) and 50% ± 5% relative humidity. Bake two hours at 200°F (93°C) prior to the application of the test paint. Apply the test paint by drawdown as above in a direction perpendicular to the long axis of the panel to obtain a dry film of 2.0 ± 0.2 mils (51 ± 5 micrometers) and a width of approximately 2" (5 cm). Allow the test paint to dry for 48 hours at 74-80°F (23-27°C) and 50% ± 5% relative humidity.

Make a cut (the entire width of the test panel) perpendicular to the long axis of the glass panel through the center of the test film with a razor blade held at a 45-degree angle. Place the panel on a Gardner Machine (described in FED-STD-141, Method 6141) so that the test paint is approximately in the center of the brush stroke and scrub underwater with the brush described in ASTM D 2486. A brush shall move in a direction parallel to the long axis of the glass panel and perpendicular to the cut made in the test film. The brush shall travel at a rate of 39 ± 1 cycles (78 ± 2 separate strokes) per minute. There shall be no adhesion failure between the test paint and the alkyd undercoat after 1,500 strokes. The paint may wear through to the alkyd enamel in less than 1,500 strokes. If this occurs, it shall not be considered as adhesion failure of the test paint.

**5.9 PACKAGE STABILITY:** Perform the following tests in accordance with ASTM D 1849. When stored for one month at 123-127°F (51-53°C), the maximum allowable increase or decrease in viscosity shall not exceed 10 Kreb units. After brushing, the film shall be free from grains, lumps, or streaks.

**5.10 MECHANICAL STABILITY:** Fill a one quart (one liter) friction top can three-quarters full with the primer and close the can tightly. Rotate on a jar roller for 168 hours at 120-170 rpm. At the end of 168 hours, there shall be no indication of separation, coagulation, excessive thickening or loss in mechanical stability. The maximum allowable increase or decrease in viscosity shall not exceed 10 Krebs units.

**5.11 COALESCENCE TEST:** Apply the primer to two 4" x 8" (10 cm x 20 cm) cold-rolled steel panels to produce a dry film thickness of 2.0 ± 0.5 mils (50 ± 13 micrometers).

Provided by : www.spic.ir Licensee: NISOC Library

(a) Allow one panel to dry for four hours at 50% ± 5% relative humidity and at 47-53°F (8-12°C).

(b) Allow the other panel to dry four hours at the same relative humidity as the first and at 74-80°F (23-27°C).

At the end of the four hour drying period, allow both panels to remain at condition (b) above for 24 hours. At the end of 24 hours, brush one coat of alkyd enamel conforming to Federal Specification TT-E-506 to one-half of each panel. The enamel shall be tinted with lampblack to 45%-55% apparent daylight reflectance. At the end of 24 hours, examine the enameled portion of the two panels for a difference in gloss. Differences in enamel hold-out will indicate unsatisfactory coalescence.

**5.12 FILM IRREGULARITY:** Apply one coat of the latex primer by the drawdown method to a 4" x 8" (10 cm x 20 cm) cold-rolled steel panel to produce a dry film thickness of 4.0 ± 0.5 mils (102 ± 13 micrometers). Allow to dry at 74- 80°F (23-27°C) and 50% ± 5% relative humidity for 24 hours. Examine the film for mud-cracking, alligatoring, or other film irregularity; there shall be none.

**5.13 SALT SPRAY AND BLISTER RESISTANCE:** Prepare quadruplicate 4 x 8 inch (10 x 20 cm) by 24 gauge panels according to ASTM D 609, Type 2 steel. Spray apply two coats (allow 48 hours drying time between coats) to produce a total dry film thickness of 4.0-4.5 mils (102-114 micrometers). Allow to dry at 74-80°F (23-27°C) and at 50% ± 5% relative humidity for 14 days. Coat and seal all edges and the backside of each panel with a suitable protective coating.

Scribe a 3" (8 cm) "X" through the middle portion of the painted panels so as to expose the underlying metal before testing. The conditions of making the scratch shall be as described in ASTM D 1654.

Expose duplicate panels in the salt fog box at an angle of 15 degrees from the vertical for 300 hours according to ASTM B 117. Examine the panels at 72-hour intervals for rusting and blistering. At the end of 300 hours, immediately examine for rusting and blistering. The rusting shall not exceed "8" according to SSPC-VIS 2 or ASTM D 610, and the blistering shall not exceed "8F" according to ASTM D 714. After examining the panels for blistering, immediately remove the paint film with a suitable organic solvent. If scraping of the paint film is necessary to remove it, do not use a metal spatula or razor blade; use a piece of soft wood. Examine the steel substrate. The rusting shall not exceed "9" as judged by SSPC-VIS 2 or ASTM D 610. The rust creep, as judged by the bare panel, shall not exceed 1/8" (3 mm) from the center of the scribe.

Expose the other pair of duplicate panels on a Cleveland Condensing Cabinet according to ASTM D 2247 for 300 hours at 100°F (38°C). Examine the panels at 72-hour intervals for rusting and blistering. At the end of 300 hours, immediately examine for rusting and blistering. The rusting shall no exceed "8" according to SSPC-VIS 2 or ASTM D 610 and the blistering shall not exceed "8F" according to ASTM D 714. After examining the panels for blistering, immediately remove the paint film with a suitable organic solvent. If scraping of the paint film is necessary to remove it, do not use a metal spatula or razor blade; use a piece of soft wood. Examine the steel substrate. The rusting shall not exceed "9" as judged by SSPC-VIS 2 or ASTM D 610. The rust creep, as judged by the bare panel, shall not exceed 1/8" ( 3 mm) from the center of the scribe.

**5.14 FLASH RUST RESISTANCE TEST:** Apply one coat of the primer at 1.5 mils (38 micrometers) dry film thickness to a panel prepared according to ASTM D 609, Type 2 steel. Allow the panel to dry in a horizontal position for 48 hours at 74-80°F (23-27°C) and 50% ± 5% relative humidity. At the end of the drying period, examine for flash rusting or rust bleeding. The primer shall show no rust bleed and the steel shall not show any corrosion when the latex film is removed.

**5.15 WET ABRASION RESISTANCE:** Test the primer as described in ASTM D 2486. Air dry the panel for seven days in an open room kept at 74-80°F (23-27°C) and 50% ± 5% relative humidity before testing. A minimum of 800 strokes or 400 oscillations shall be required to fully remove the paint film on one continuous line across the width of the 1/2" (13 mm) shim.

**5.16 FLEXIBILITY:** Flexibility shall be determined in accordance with ASTM D 1737 using a 1/4" (6 mm) mandrel and an unscribed panel as described below. Apply a 2" (5 cm) wide film of the paint with a film applicator that will give a dry film thickness of 0.9 to 1.1 mils (23-28 micrometers) on a smooth finish steel panel, prepared in accordance with ASTM D 609, paragraph 5.3 Method C, using the aliphatic naphtha-ethylene glycolmonoethyl ether mixture. The panel shall be new, cold-rolled, rust-free carbon steel No. 20 gage 0.0375" ± 0.0125" (0.95 mm ± 0.31 mm) thickness with a Rockwell 15T maximum hardness of 82 and finished with a surface roughness of 8-12 microinches (0.2-0.3 micrometers). The coated panel shall air dry for 24 hours at a temperature of 74-80°F (23-27°C) and then is put in an oven at 98-102°F (37-39°C) for four days. Condition the panel at 74-80°F (23-27°C) for two hours. Bend panel over a 1/4" (6 mm) mandrel. Examine the bend for paint cracking in a strong light at a seven diameter magnification. There shall be no visible cracking.

**5.17 MILDEW RESISTANCE:** When tested as specified in ASTM D 3273, the paint shall show no more mildew than disfigurement "8" when compared with the photographic standards of ASTM D 3274.

Provided by : www.spic.ir Licensee: NISOC Library

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legibly marked with the following information:

Name: Latex Primer for Steel Surfaces
Specification: SSPC-Paint 23
Color:
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warning as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of Latex Primer for Steel Surfaces

This paint is intended for use as a primer over blast cleaned steel in atmospheric exposure. It is intended for use as a primer coat of a water-borne coating system consisting of two coats of this primer and one or two coats of a water-borne topcoat (SSPC-Paint 24). It may also be used over previously coated surfaces, galvanized steel, and aluminum surfaces.

Mix paint thoroughly before use. If the pigment has settled, pour off most of the liquid. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring contents to a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

Thin paint only if necessary, using only deionized or potable water. For brush application under normal conditions, no thinning should be necessary. For spray applications, add up to one-half pint of thinner per gallon (60 ml/L) of paint when necessary.

This paint may be applied by spray or brush. Cross brushing or cross spraying application is highly desirable. Application by spray tends to provide the best leveling. Since one-coat systems have very limited protective properties, multiple coat systems shall always be applied. Apply to the specified film thickness or, if none is specified, to at least 2.0 mils (51 micrometers) dry or approximately 6 mils (152 micrometers) wet.

The atmospheric conditions at the time this coating is applied are extremely important. This primer shall not be applied at a temperature below 50°F (10°C) or above 120°F (49°C).

The best conditions for storage of this coating are at temperatures between 40°F (4°C) and 80°F (27°C). This coating should never be allowed to attain temperatures over 120°F (49°C), or subjected to repeated freezing and thawing.

Allow paint at least 24 hours drying time in good weather before recoating.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 24
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 24

## Latex Semigloss Exterior Topcoat

### 1. Scope

**1.1** This specification covers an air drying, ready-mixed, water-borne semigloss latex paint for use on metal surfaces primed with a primer conforming to SSPC-Paint 23. It is intended for use as a topcoat of a water-borne coating system consisting of two coats of primer and one or two coats of this water-borne topcoat.

**1.2** This paint is suitable for exposures in Environmental Zones 1A (interior, normally dry) and 1B (exterior, normally dry), and is intended for brush, spray, or roller application over properly primed steel surfaces and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel." It is not recommended to expose steel to the weather with less than two coats of waterborne coating; therefore, intermediate and topcoats should be applied as soon as possible.

### 2. Description

**2.1** This paint is based on a latex vehicle produced by emulsion polymerization and appropriate pigments. Details of the composition are given in Table 1.

**2.2** This paint contains approximately 27% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 2.0 mil (51 micrometers) dry film thickness is 215 square feet/U.S. gallon (5.3 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **Paint 23** | Latex Primer for Steel Surfaces |
| **VIS 2** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **B 117** | Method of Salt Spray (Fog) Testing |
| **D 522** | Test Method for Mandrel Bend Test of Attached Organic Coatings |
| **D 523** | Test Method for Specular Gloss |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 609** | Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products |
| **D 610** | Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces |
| **D 714** | Test Method for Evaluating Degree of Blistering of Paints |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 1640** | Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature |
| **D 1654** | Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments |
| **D 1737** | (Canceled) Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus (Replaced with ASTM D 522) |
| **D 1849** | Test Method for Package Stability of Paint |
| **D 2243** | Test Method for Freeze-Thaw Resistance of Water-Borne Coatings |
| **D 2244** | Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates |
| **D 2247** | Practice for Testing Water Resistance of Coatings in 100% Relative Humidity |
| **D 2486** | Test Method for Scrub Resistance of Interior Latex Flat Wall Paints |
| **D 2574** | Test Method for Resistance of Emulsion Paints in the Container to Attack by Microorganisms |
| **D 2801** | (Canceled) Test Method for Leveling Characteristics of Paints by Draw-Down |

Provided by : www.spic.ir Licensee: NISOC Library

Method (See ASTM D 4400.)

**D 3273** Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

**D 3274** Test Method for Evaluating Degree of Surface Disfigurementof Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation

**D 3925** Practice for Sampling Liquid Paints and Related Pigmented Coatings

**D 4400** Test Method for Sag Resistance of Paints Using a Multinotch Applicator

**E 11** Specification for Wire-Cloth Sieves for Testing Purposes

**E 97** (Canceled) Test Method for Directional Reflectance Factor, 45-deg 0-deg, of Opaque Specimens by Broad-Band Filter Reflectometry (Use ASTM E 11)

**G 23** (Canceled) Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials (See ASTM G 151 and G 155.)

**G 26** (Canceled) Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials (See ASTM G 155.)

**G 151** Standard Practice for Exposing Non-Metallic Mateials in Accelerated Test Devices that Use Laboratory Light Sources

**G 152** Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

**3.6 FEDERAL STANDARDS:**

**TT-E-506** Enamel, Alkyd, Gloss, Tints and White (for Interior Use)

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

**Method 2021** Preparation of Glass Panels
**Method 6141** Washability

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

**Z129.1** Hazardous Industrial Chemicals—Precautionary Labeling

## 4. Composition

**4.1** The manufacturer is given some latitude in the selection of materials and process of manufacture, provided that the paint meets the requirements of this specification. Materials shall be of the best quality used in good commercial practice and entirely suitable for the purpose intended under normal conditions of use.

**4.2** The vehicle shall be a stable dispersion of synthetic resin particles (latex) in water prepared by emulsion polymerization, together with the necessary additives such as pigment dispersant, antifoamer, preservatives, and "anti-freeze" in order to produce a paint conforming to this specification. A suitable film and package preservative shall be used.

**4.3** The paint shall conform to the composition (analysis) requirements of Table 1.

## 5. Properties

**5.1** The paint shall meet the requirements of Table 2 and Sections 5.2 through 5.17.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296). In a freshly opened container, there shall be no offensive, disagreeable, or putrid odor.

**5.3 COLOR:** The color shall be as specified in the procurement documents.

**5.4 RESISTANCE TO MICROORGANISM ATTACK:** The paint shall be resistant to attack by microorganisms when tested according to ASTM D 2574.

**5.5 APPLICATION PROPERTIES:** The paint shall be easily applied to a smooth steel vertical surface at 5 mils (127 micrometers) wet film thickness on 320 square feet/gallon (7.9 square meters/liter) by brush, spray, or roller. Drying shall be done in a well-ventilated room or chamber free from drafts and dust and in diffused light, not in direct sunlight. The temperature of the air shall be between 21 and 28°C. The relative humidity shall be 50% ± 5%. There shall be no runs, sags, streaks, flashes, laps, pinholes, fisheyes, or craters. After four hours of drying, apply a second coat in the same manner as the first. There shall be no picking-up or rolling-up of the first coat during applications. After 24 hours, the film shall be smooth and uniform.

**5.6 CONDITION IN CONTAINER:** The paint as received shall show no evidence of livering, skinning, or hard settling of the pigment. The inside of the container shall not be corroded. The material shall be easily dispersed in the

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**ANALYSIS**

| CHARACTERISTICS[1] | REQUIREMENTS Min. % | Max. % | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Nonvolatile vehicle | 26 | — | — | — |
| Total Solids by Volume | 27 | — | — | — |

[1] Theoretical as calculated.

**TABLE 2**
**PROPERTIES**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Viscosity* shear rate 200 rpm | | | | |
| Grams | 150 | 240 | D 562 | — |
| Kreb units | 72 | 88 | D 562 | — |
| Fineness of grind, Hegman units | 6.0 | — | D 1210 | — |
| Drying time, hours | | | | |
| Dry to touch | — | 4 | D 1640 | — |
| Dry hard | — | 24 | D 1640 | — |
| Sag Resistance, mils | 6 | — | D 2801** | — |

*Viscosity 48 hours or more after manufacture.
**ASTM D 2801 has been replaced by ASTM D 4400.

liquid portion by hand stirring to form a smooth, homogeneous paint. The paint shall show a minimum of foaming and be free of grit, seeds, lumps, or livering.

**5.7 FREEZE-THAW RESISTANCE:** The paint shall pass three cycles when tested according to the procedure described in ASTM D 2243. There shall be no gelation, or excessive thickening, coagulation, lumps, or coarse particles. The maximum allowable increase or decrease in viscosity shall not exceed 10 Kreb units.

**5.8 WET ADHESION:** Prepare 6" x 17" x 1 /4" (15 cm x 43 cm x 0.63 cm) glass panels with a ground surface which has been cleaned according to FED-STD-141, Method 2021. Apply alkyd enamel conforming to Federal Specification TT-E-506 drawndown with a suitable applicator obtaining a dry film thickness of 3.0 ± 0.3 mils (76 ± 8 micrometers) and a width of 5-1 /2" (14 cm). Allow the alkyd enamel to dry in a horizontal position for three days at 74-80°F (23-27°C) and 50% ± 5% relative humidity. Bake two hours at 200°F (93°C) prior to the application of the test paint. Apply the test paint by drawdown as above in a direction perpendicular to the long axis of the panel to obtain a dry film of 2.0 ± 0.2 mils (51 ± 5 micrometers) and a width of approximately 2" (5 cm). Allow the test paint to dry for 48 hours at 74-80°F (23-27°C) and 50% ± 5% relative humidity.

Make a cut (the entire width of the test panel) perpendicular to the long axis of the glass panel through the center of the test film with a razor blade held at a 45-degree angle. Place the panel on a Gardner Machine (described in FED-STD-141, Method 6141) so that the test paint is approximately in the center of the brush stroke and scrub under water with the brush described in ASTM 2486. A brush shall move in a direction parallel to the long axis of the glass panel and perpendicular to the cut made in the test film. The brush shall travel at a rate of 39 ± 1 cycles (78 ± 2 separate strokes) per minute. There shall be no adhesion failure between the test paint and alkyd undercoat after 800 strokes. The paint may wear through to the alkyd enamel in less than 800 strokes. If this occurs, it shall not be considered as adhesion failure of the test paint. In the same fashion, this topcoat shall be tested over the manufacturer's primer coating complying with SSPC-Paint 23.

**5.9 PACKAGE STABILITY:** Perform the following tests in accordance with ASTM D 1849. When stored for one month at 123-127°F (51-53°C), the maximum allowable increase or decrease in viscosity shall not exceed 10 Kreb units. After brushing, the film shall be free from grains, lumps, or streaks.

Provided by : www.spic.ir Licensee: NISOC Library

**5.10 FILM IRREGULARITY:** Apply one coat of the latex paint by the drawdown method to a 4" x 8" (10 cm x 20 cm) cold-rolled steel panel to produce a dry film thickness of 4.0 ± 0.5 mils (102 ± 13 micrometers). Allow to dry at 74-80°F (23-27°C) and 50% ± 5% relative humidity for 48 hours. Examine the film for mud-cracking, alligatoring, or other film irregularity; there shall be none.

**5.11 SALT SPRAY AND BLISTER RESISTANCE:** Prepare quadruplicate 4 x 8 inch (10 x 20 cm) by 24 gage panels according to ASTM D 609, Type 2 steel. Spray apply one coat of primer SSPC-Paint 23 to a dry film thickness of 2-3 mils (51-76 micrometers) and allow to dry for 48 hours at 74-80°F (23-27°C) at 50% ± 5% relative humidity. Then spray apply one coat of this paint to a dry film thickness of 2-3 mils (51-76 micrometers). Allow the two-coat system to dry at 74-80°F (23-27°C) and at 50% ± 5% relative humidity for 14 days. Coat and seal all edges and the backside of each panel with a suitable protective coating.

Scribe a 3" (8 cm) "X" through the middle portion of the painted panels so as to expose the underlying metal before testing. The conditions of making the scratch shall be as described in ASTM D 1654.

Expose duplicate panels in the salt fog box at an angle of 15 degrees from the vertical for 300 hours according to ASTM B 117. Examine the panels at 72-hour intervals for rusting and blistering. At the end of 300 hours, immediately examine for rusting and blistering. The rusting shall not exceed "8" according to SSPC-VIS 2 or ASTM D 610, and the blistering shall not exceed "8F" according to ASTM D 714. After examining the panels for blistering, immediately remove the paint film with a suitable organic solvent. If scraping of the paint film is necessary to remove it, do not use a metal spatula or razor blade. Use a piece of soft wood. Examine the steel substrate. The rusting shall not exceed "9" as judged by SSPC-VIS 2 or ASTM D 610. The rust creep, as judged by the bare panel, shall not exceed 1/8" (3 mm) from the center of the scribe.

Expose the other pair of duplicate panels on a Cleveland Condensing Cabinet according to ASTM D 2247 for 300 hours at 100°F (38°C). Examine the panels at 72-hour intervals for rusting and blistering. At the end of 300 hours, immediately examine for rusting and blistering. The rusting shall not exceed "8" according to SSPC-VIS 2 or ASTM D 610, and the blistering shall not exceed "8F" according to ASTM D 714. After examining the panels for blistering, immediately remove the paint film with a suitable organic solvent. If scraping of the paint film is necessary to remove it, do not use a metal spatula or razor blade. Use a piece of soft wood. Examine the steel substrate. The rusting shall not exceed "9" as judged by SSPC-VIS 2 or ASTM D 610. The rust creep, as judged by the bare panel, shall not exceed 1/8" (3 mm) from the center of the scribe.

**5.12 WET ABRASION RESISTANCE:** Test the paint as described in ASTM D 2486. Air dry the panel for seven days in an open room kept at 74-80°F (23-27°C) and 50% ± 5% relative humidity before testing. A minimum of 800 strokes or 400 oscillations shall be required to fully remove the paint film on one continuous line across the width of the 1/2"(13 mm) shim.

**5.13 FLEXIBILITY:** Flexibility shall be determined in accordance with ASTM D 1737 using a 1/4" (6 mm) mandrel and an unscribed panel as described below. Apply a 2" (5 cm) wide film of the paint with a film applicator that will give a dry film thickness of 0.9 to 1.1 mils (23-28 micrometers) on a smooth finish steel panel, prepared in accordance with ASTM D 609, paragraph 5.3 Method C, using the aliphatic naphtha-ethylene glycolmonoethyl ether mixture. The panel shall be new, cold-rolled, rust-free carbon steel No. 20 gage 0.0375" ± 0.0125" (0.95 mm ± 0.31 mm) thickness with a Rockwell 15T maximum hardness of 82 and finished with a surface roughness of 8-12 microinches. The coated panel shall air dry for 24 hours at a temperature of 74-80°F (23-27°C) and then put in an oven at 98-102°F (37-39°C) for four days. Condition the panel at 74-80°F (23-27°C) for two hours. Bend panel over a 1 /4" (6 mm) mandrel. Examine the bend for paint cracking in a strong light at a seven diameter magnification. There shall be no visible cracking.

**5.14 MILDEW RESISTANCE:** When tested as specified in ASTM D 3273, the paint shall show no more mildew than disfigurement "8" when compared with the photographic standards of ASTM D 3274.

**5.15 GLOSS AFTER EXPOSURE:** Coat duplicate suitable size anodized aluminum panels with two coats of this latex topcoat. Apply each coat at a dry film thickness of 2.0 ± 0.3 mils (51 ± 7 micrometers). Allow first coat to dry 24 hours at 74-80°F (23-27°C). Then apply the second coat to give a total dry film thickness of 4.0 ± 0.5 mils (102 ± 13 micrometers). Allow the two coats to dry 7 days at 74-80°F (23-27°C). Measure the 60 degree specular gloss according to ASTM D 523. Then subject the panels to light and water exposure for 400 hours according to ASTM G 23 or ASTM G 26. After exposure rinse the panels with clean water, allow to dry at room temperature for one hour, and again measure the 60 degree specular gloss. The gloss shall be no less than 80% of the original value.

**TABLE 3**
**HIDING POWER (CONTRAST RATIO)**

| DIRECTIONAL REFLECTANCE, % | MINIMUM CONTRAST RATIO |
|---|---|
| 74 to 71 | 0.96 |
| 70 to 67 | 0.97 |
| 66 to 63 | 0.98 |
| 62 and lower | 0.99 |

Provided by : www.spic.ir Licensee: NISOC Library

**5.16 HIDING POWER (CONTRAST RATIO):** Determine the contrast ratio in accordance with ASTM D 2805. Use a film applicator that will deposit a 3 inch (8 cm) wide film with a dry film thickness of 1 mil (25 micrometers). Air dry for 48 hours at 74-80°F (23-27°C). Determine the 45 degree, 0 degree directional reflectance according to ASTM E 97. Verify the thickness in the area in which the reflectance was measured. Calculate the contrast ratio and check for compliance.

The minimum contrast ratio shall be 0.95 for paints that have a reflectance of 75% or more. For paints that have a directional reflectance of less than 75%, use the values in Table 3 for minimum contrast ratios. For the reflectance of chromatic specimens see ASTM D 2244.

**5.17 DIRECTIONAL REFLECTANCE:** Determine the 45 degree, 0 degree directional reflectance according to ASTM E 97. For white paints it shall not be less than 75%.

## 6. Labeling

**6.1** Refer to ANSI Standard Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legibly marked with the following information:

Name: Latex, Semigloss Exterior Topcoat
Specification: SSPC-Paint 24
Color:
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of Latex, Semigloss Exterior Topcoat

This paint is intended for use as a topcoat over properly primed steel in atmospheric exposure. It is intended for use as a topcoat of a water-borne coating system consisting of two coats of primer (SSPC-Paint 23) and one or two coats of this water-borne topcoat (SSPC-Paint 24).

Mix paint thoroughly before use. If the pigment has settled, pour off most of the liquid. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring contents to a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

Thin paint only if necessary, using only deionized or potable water. For brush application under normal conditions, no thinning should be necessary. For spray applications add up to one half pint of thinner per gallon (60 ml/L) of paint when necessary.

This paint may be applied by spray or brush. Cross brushing or cross spraying application is highly desirable. Application by spray tends to provide the best leveling. Apply to the specified film thickness or, if none is specified, to at least 2.0 mils (51 micrometers) dry or approximately 7 mils (178 micrometers) wet.

The atmospheric conditions at the time this coating is applied are extremely important. This paint shall not be applied at a temperature below 50°F (10°C) or above 120°F (49°C).

The best conditions for storage of this coating are at temperatures between 40°F (4°C) and 80°F (27°C). This coating shall never be allowed to attain temperatures over 120°F (49°C), or subjected to repeated freezing and thawing.

Allow paint at least 24 hours drying time in good weather before recoating.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obliga-

Provided by : www.spic.ir Licensee: NISOC Library

tion resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 25
May 1, 1997
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 25

## Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel Type I and Type II

## 1. Scope

**1.1** This specification covers a slow drying French process zinc oxide, raw linseed oil and alkyd primer suitable for use over hand-cleaned steel.

**1.2** This primer is suitable for exposures in Environmental Zones 1A (interior, normally dry) and 1B (exterior, normally dry), and is intended for brush, roller or spray application over steel surfaces prepared in accordance with SSPC-SP 2, "Hand Tool Cleaning," or better. (See Note 9.6.) Within the limitation stated in 2.1 it is suitable as a shop primer, field primer, maintenance primer, or intermediate coat and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel." If the primed part of the structure is to be exposed to the weather, it should be topcoated as soon as practical.

## 2. Description

**2.1** This specification contains requirements to ensure barrier inhibition composition. Consequently, performance is comparable to that customarily expected from paints containing lead and chromate pigments.

It has good wetting ability, even for non-blast cleaned steel, about 36 hours drying time (generally it can be recoated after 24 hours, although the coating will not have achieved a through dry) and good resistance to weathering before field coating. The good wetting ability of this primer is the result of its high proportion of raw linseed oil. Type II has a lower percentage of volatile organic compounds (VOC) than Type I. The reduced VOC content of Type II was achieved by replacing some of the mineral spirits with high flash naphtha and by making other minor composition changes. Details of the compositions are given in Table 1 for Type I and in Table 2 for Type II.

**2.2** The Type I primer contains approximately 65% by volume of nonvolatile film forming solids (pigment and binder). The theoretical spreading rate for a 50 micrometer (2.0 mil) dry film thickness is 12.8 $m^2$/L (520 $ft^2$/U.S. gallon). Actual spreading rates can be significantly lower. On a calculated basis, the VOC is 270 g/L(2.3 lb/gal).

**2.3** The Type II primer contains approximately 70% by volume of nonvolatile film forming solids (pigment and binder). The theoretical spreading rate for a 50 micrometer (2.0 mil) dry film thickness is 13.8 $m^2$/L (560 $ft^2$/U.S. gallon). Actual spreading rates can be significantly lower. On a calculated basis, the VOC content is 240 g/L (2.0 lbs/gal).

## 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.8 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **Guide 7** | Guide for the Disposal of Lead-Contaminated Surface Preparation Debris |
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Metal Blast Cleaning |
| **SP 11** | Power Tool Cleaning to Bare Metal |
| **SP 12/NACE No. 5** | Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating |

**3.6 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 79** | Specification for Zinc Oxide |
| **D 185** | Test Method for Coarse Particles in Pigments, Pastes and Paints |
| **D 234** | Specification for Raw Linseed Oil |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **D 235** | Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent) |
| **D 522** | Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 600** | Specification for Liquid Paint Driers |
| **D 605** | Specification for Magnesium Silicate Pigment (Talc) |
| **D 607** | Specification for Wet Ground Mica Pigments |
| **D 1208** | Test Methods for Common Properties of Certain Pigments |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1296** | Test Method for Odors of Volatile Solvents and Diluents |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1542** | Test Method for Quantitative Test for Rosin in Varnishes |
| **D 1640** | Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 2371** | Test Method for Pigment Content of Solvent-Reducible Paints |
| **D 2448** | Test Method for Water-Soluble Salts in Pigments by Measuring the Specific Resistance of the Leachate of the Pigment |
| **D 2832** | Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings |
| **D 3278** | Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus |
| **D 3722** | Specification for Natural Red and Brown Iron Oxide Pigments |
| **D 3724** | Specification for Synthetic Brown Iron Oxide Pigment |
| **D 3734** | Specification for High-Flash Aromatic Naphthas |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**TABLE 1**
**COMPOSITION**
**SSPC-Paint 25, Type I**

| | REQUIRED | | TYPICAL COMPOSITION | | INGREDIENT STANDARDS | |
|---|---|---|---|---|---|---|
| **INGREDIENTS** | **Min. Wt.%** | **Max. Wt. %** | **Wt. %** | **Vol. %** | **ASTM** | **FEDERAL** |
| PIGMENT*: (52.5 ± 2 wt. %) | | | | | | |
| Zinc Oxide | 15.0 | 17.0 | 8.4 | 2.2 | D 79, Dry Pigment, French Process | — |
| Iron Oxide (85% minimum $Fe_2O_3$) | 39.0 | — | 21.5 | 7.9 | D 3722/D 3724 | — |
| Magnesium Silicate | — | 33.0 | 17.3 | 9.1 | D 605 | — |
| Mica | 10.0 | 12.0 | 5.3 | 2.7 | D 607 | — |
| TOTAL PIGMENT: | 100 | | 52.5 | 21.9 | | |
| VEHICLE: (47.5 ± 2 wt. %) | | | | | | |
| Raw Linseed Oil | 30.5 | — | 14.5 | 23.2 | D 234 | — |
| Alkyd Resin Solids | 30.5 | — | 14.5 | 19.8 | — | TT-R-266, Type I Class A Type II Class B |
| Mineral Spirit Thinner | — | 39.0 | 18.5 | 35.0 | D 235 | — |
| Driers | — | — | — | — | D 600, Non-Lead | — |
| TOTAL VEHICLE: | 100 | | 47.5 | 78 | | |
| TOTAL: | | | 100 | 100 | | |

The preblended composite pigment shall comply with the following:

| PROPERTY | METHOD | REQUIRED |
|---|---|---|
| pH | — | 7 to 8 |
| Specific Resistance of Leachate | ASTM D 2448 | 5000 ohm-cm minimum |

*See Note 9.3 for supplier of preblended pigment and Note 9.4 for properties of component pigments.

Provided by : www.spic.ir Licensee: NISOC Library

**D 3951** Practice for Commercial Packaging
**D 4400** Test Method for Sag Resistance of Paints Using a Multinotch Applicator

**3.7 FEDERAL SPECIFICATIONS AND STANDARDS:**

**TT-R-266** Resin, Alkyd: Solutions

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

**Method 3011** Condition in Container
**Method 3021** Skinning (Partially Filled Container)
**Method 4203** Reducibility and Dilution Stability
**Method 4321** Brushing Properties
**Method 4331** Spraying Properties
**Method 4541** Working Properties and Appearance of Dried Film

**3.8 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

**ANSI Z129.1** Hazardous Industrial Chemicals —Precautionary Labeling

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1 for Type I and in Table 2 for Type II.

**4.2** The primers based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. No rosin or rosin derivatives may be used. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added.

**4.3** The paint shall conform to the composition (analysis) requirements of Table 3.

## 5. Properties

**5.1** The primers for Type I and Type II shall meet the requirements of Tables 3 and 4 and of Sections 5.2 through 5.8.

**TABLE 2**
**COMPOSITION**
**SSPC-Paint 25, Type II**

| | REQUIRED | | TYPICAL COMPOSITION | | INGREDIENT STANDARDS | |
|---|---|---|---|---|---|---|
| | Min. | Max. | | | | |
| INGREDIENTS | Wt.% | Wt. % | Wt. % | Vol. % | ASTM | FEDERAL |
| PIGMENT*: (54.0 ± 2 wt. %) | | | | | | |
| Zinc Oxide | 15.0 | 17.0 | 8.6 | 2.4 | D 79, Dry Pigment, French Process | — |
| Iron Oxide (85% minimum $Fe_2O_3$) | 39.0 | — | 22.2 | 8.3 | D 3722/D 3724 | — |
| Magnesium Silicate | — | 33.0 | 17.8 | 9.7 | D 605 | — |
| Mica | 10.0 | 12.0 | 5.4 | 2.9 | D 607 | — |
| TOTAL PIGMENT: | 100 | | 54.0 | 23.3 | | |
| VEHICLE: (46.0 ± 2 wt. %) | | | | | | |
| Raw Linseed Oil | 30.5 | — | 15.3 | 25.5 | D 234 | — |
| Alkyd Resin Solids | 30.5 | — | 15.3 | 21.7 | — | TT-T-266, Type I Class A Type II Class B |
| Mineral Spirit Thinner | — | 22.9 | 10.5 | 20.8 | D 235 | — |
| High Flash Naphtha | — | 10.7 | 4.9 | 8.7 | D 3734 | — |
| Driers | — | — | — | — | D 600, Non-Lead | — |
| TOTAL VEHICLE: | 100 | | 46.0 | 76.7 | | |
| TOTAL: | | | 100 | 100 | | |

The preblended composite pigment shall comply with the following:

| PROPERTY | METHOD | REQUIRED |
|---|---|---|
| pH | — | 7 to 8 |
| Specific Resistance of Leachate | ASTM D 2448 | 5000 ohm-cm minimum |

*See Note 9.3 for supplier of preblended pigment and Note 9.4 for properties of component pigments.

Provided by : www.spic.ir Licensee: NISOC Library

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**5.3 COLOR:** The color shall be typical of the specified mixture of zinc oxide and red or brown iron oxide.

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when two volumes of the paint are slowly mixed with one volume of mineral spirits (FED-STD-141, Method 4203).

**5.5 WORKING PROPERTIES:** The paint shall be easily applied by brush, roller, or spray when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging during application or while drying.

**5.6 CONDITION IN CONTAINER:** The paint shall show no thickening, curdling, gelling, or hard caking when tested as specified in FED-STD-141, Method 3011, after storage for six months from the date of delivery, in a full, tightly covered container, at a temperature of 10-43°C (50-110°F).

**5.7 SKINNING:** There shall be no skinning in a three-quarters filled closed container after 48 hours when tested in the standard manner specified in FED-STD-141, Method 3021.

**5.8 SALT CONTAMINATION:** Content of salt contamination shall have been minimized by the incorporation of only high purity materials. The specific resistance of the aqueous leachate of the composite of the pigments in required proportions shall be a minimum of 5,000 ohm-cm when tested in accordance with ASTM D 2448.

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legibly marked with the following information:

Name: Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I (or Type II)
Specification: SSPC-Paint 25
Color: Red or Brown Iron Oxide
Lot Number:
Batch Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
VOC Content:
Manufacturer's Name and Address:

**6.3 PACKAGING:** Material shall be packaged and labeled in accordance with the requirements of ASTM D 3951 unless otherwise specified.

**6.4 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of Zinc Oxide,
Alkyd, Linseed Oil Primer for Use Over
Hand Cleaned Steel

**TABLE 3**
**ANALYSIS**

| | REQUIREMENTS | | | |
|---|---|---|---|---|
| **CHARACTERISTICS** | **Min. Wt. %** | **Max. Wt. %** | **ASTM** | **FED-STD-141** |
| Pigment content | | | | |
| Type I | 50.5 | 54.5 | D 2371 | — |
| Type II | 52.0 | 56.0 | D 2371 | — |
| Volatiles | | | | — |
| Type I | — | 19.3 | D 2369 | — |
| Type II | — | 16.1 | D 2369 | — |
| Nonvolatile vehicles | | | | |
| Type I | 27.8 | — | — | — |
| Type II | 26.8 | — | — | — |
| Uncombined water | — | 1.0 | D 1208 | — |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 1.5 | D 185 | — |
| Rosin or rosin derivatives | — | 0 | D 1542 | — |

Provided by : www.spic.ir Licensee: NISOC Library

This paint is intended for use as a primer over hand cleaned steel in atmospheric exposure; it will perform better if the steel is power tool cleaned, blast cleaned, or pickled. All rust scale, loose rust, loose mill scale, and loose or non-adherent paint shall be removed; oil and grease shall be removed to the fullest extent practical, as residues of oil and grease remaining on the surface will result in decreased paint performance.

Mix paint thoroughly before use. If the pigment has settled, pour off most of the liquid. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring the contents to a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

The thinning of paint will change the VOC level. For roller, brush, or airless spray application, no thinning should be necessary. A minimum amount of thinning may be necessary for conventional air spray.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 50 micrometers (2 mils) dry or approximately 75 micrometers (3 mils) wet. The surface to be painted shall be dry, the surface temperature shall be at least 3 C° (5 F°) above the dew point and the temperature of the air shall be over 4°C (40°F). Do not paint outdoors in rainy weather or if freezing temperatures are expected before the paint dries.

Allow paint at least 24 hours drying time before recoating.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

**TABLE 4**
**PROPERTIES**

| | REQUIREMENTS | | | |
|---|---|---|---|---|
| | Min. | Max. | | |
| CHARACTERISTICS | Wt. % | Wt. % | ASTM | FED-STD-141 |
| Consistency* shear rate 200 rpm | | | | |
| Grams | 175 | 225 | D 562 | — |
| Krebs units | 77 | 86 | D 562 | — |
| Density, kg/L (lb/US gal) | | | | |
| Type I | 1.48 (12.3) | — | D 1475 | — |
| Type II | 1.54 (12.8) | — | D 1475 | — |
| Fineness of grind, Hegman units | 3.0 | — | D 1210 | — |
| Drying time, hours | | | | |
| Tack free | — | 20 | — | 4061 |
| Dry hard | — | 36 | — | 4061 |
| Flash point, °C (°F) | 38 (100) | — | D 3278 | — |
| Sag resistance, mm (mils) | 0.18 (7) | 0.25 (10) | D 4400 | — |

*Consistency 48 hours or more after manufacture.

Provided by : www.spic.ir Licensee: NISOC Library

## 9. Notes

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**9.2** The extraction of chlorides and other anions from corrosion pits in severe corrosivity areas of the structure is recommended.

**9.3** The preblended composite pigment can be obtained from Hoover Color Corporation, P. O. Box 218, Hiwasse, VA 24347; Phone (703) 980-7233.

**9.4** During the development of SSPC-Paint 25, the purity of each pigment was measured in accordance with ASTM D 2448. The specific resistances of the leachate for the individual pigments were as follows:

French process zinc oxide ..... 20,000 ohm-cm
Iron oxide ..... 5,000 ohm-cm
Magnesium silicate ..... 2,800 ohm-cm
Mica ..... 17,000 ohm-cm

The calculated resistance for the formula blend using these purities for the individual paints is 5000 ohm-cm.

**9.5** Handle wastes in accordance with federal, state and local government regulations. See SSPC-Guide 7, "Guide for the Disposal of Lead-Contaminated Surface Preparation Debris."

**9.6** The following degrees of surface preparation are better than SSPC-SP 2, "Hand Tool Cleaning": SSPC-SP 3, SSPC-SP 5/NACE No. 1, SSPC-SP 6/NACE No. 3, SSPC-SP 7/NACE No. 4, SSPC-SP 8, SSPC-SP 10/NACE No. 2, SSPC-SP 11, SSPC-SP 12 /NACE No. 5.

**9.7** Type I of this specification very closely matches the previous version of SSPC-Paint 25.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 25 BCS
May 1, 1997
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 25 BCS

## Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Blast Cleaned Steel Type I and Type II

## 1. Scope

**1.1** This specification covers a French process zinc oxide, raw linseed oil and alkyd primer suitable for use over blast cleaned steel.

**1.2** This is an alkyd/linseed oil primer containing 30% more alkyd resin than SSPC Paint 25. It is not recommended for hand cleaned steel.

**1.3** This primer is suitable for exposures in Environmental Zones 1A (interior, normally dry) and 1B (exterior, normally dry), and is intended for brush, roller, or spray application over steel surfaces prepared in accordance with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning," or SSPC-SP 11, "Power Tool Cleaning to Bare Metal," or better. (See Note 9.6.) It is suitable as a shop primer, field primer, maintenance primer, or intermediate coat and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel." If the primed part of the structure is to be exposed to the weather, it should be topcoated as soon as practical.

## 2. Description

**2.1** This specification contains requirements to ensure performance that is comparable to that customarily expected from paints containing lead and chromate pigments.

It has fair wetting ability, about 18 hours drying time and good resistance to weathering before field coating. The wetting ability of this primer is the result of one third of the binder being raw linseed oil. Type II has a lower percentage of volatile organic compounds (VOC) thanType I. The reduced VOC content of Type II was achieved by replacing some of the mineral spirits with high flash naphtha and by making other minor composition changes. Details of the compositions are given in Table 1 for Type I and in Table 2 for Type II.

**2.2** The Type I primer contains approximately 65% by volume of nonvolatile film forming solids (pigment and binder). The theoretical spreading rate for a 50 micrometer (2.0 mil) dry film thickness is 12.8 $m^2$/L (520 $ft^2$/U.S. Gallon). Actual spreading rates can be significantly lower. On a calculated basis, the VOC content is 270 grams per liter (2.3 lb/gal).

**2.3** The Type II primer contains approximately 72% by volume of nonvolatile film forming solids (pigment and binder). The theoretical spreading rate for a 50 micrometer (2.0 mil) dry film thickness is 14.2 $m^2$/L (580 $ft^2$/U.S. gallon). Actual spreading rates can be significantly lower. On a calculated basis, the VOC content is 220 g/L (1.9 lb/gal).

## 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.8 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **Guide 7** | Guide for the Disposal of Lead-Contaminated Surface Preparation Debris |
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **Paint 25** | Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 10/NACE No. 2** | Near-White Metal Blast Cleaning |
| **SP 11** | Power Tool Cleaning to Bare Metal |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 79** | Specification for Zinc Oxide Pigments |
| **D 185** | Test Method for Coarse Particles in Pigments, Pastes and Paints |
| **D 234** | Specification for Raw Linseed Oil |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **D 235** | Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent) |
| **562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 600** | Specification for Liquid Paint Driers |
| **D 605** | Specification for Magnesium Silicate Pigment (Talc) |
| **D 607** | Specification for Wet Ground Mica Pigments |
| **D 1208** | Test Methods for Common Properties of Certain Pigments |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1296** | Test Method for Odors of Volatile Solvents and Diluents |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1542** | Test Method for Quantitative Test for Rosin in Varnishes |
| **D 1640** | Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 2371** | Test Method for Pigment Content of Solvent-Reducible Paints |
| **D 2448** | Test Method for Water-Soluble Salts in Pigments by Measuring the Specific Resistance of the Leachate of the Pigment |
| **D 2832** | Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings |
| **D 3278** | Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus |
| **D 3722** | Specification for Natural Red and Brown Iron Oxide Pigments |
| **D 3724** | Specification for Synthetic Brown Iron Oxide Pigment |
| **D 3734** | Specification for High-Flash Aromatic Naphthas |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |
| **D 3951** | Practice for Commercial Packaging |
| **D 4400** | Test Method for Sag Resistance of Paints Using a Multinotch Applicator |

**TABLE 1**
**COMPOSITION**
**SSPC-Paint 25 BCS, Type I**

| | REQUIRED | | TYPICAL COMPOSITION | | INGREDIENT STANDARDS | |
|---|---|---|---|---|---|---|
| **INGREDIENTS** | **Min. Wt.%** | **Max. Wt. %** | **Wt. %** | **Vol. %** | **ASTM** | **FEDERAL** |
| PIGMENT*: (52.5 ± 2 wt. %) | | | | | | |
| Zinc Oxide | 15 | 17.0 | 8.4 | 2.3 | D 79, Dry Pigment, French Process | — |
| Iron Oxide (85% minimum $Fe_2O_3$) | 39.0 | — | 21.5 | 7.9 | D 3722/D 3724 | — |
| Magnesium Silicate | — | 33.0 | 17.3 | 9.2 | D 605 | — |
| Mica | 10.0 | 12.0 | 5.3 | 2.8 | D 607 | — |
| TOTAL PIGMENT: | 100 | | 52.5 | 22.2 | | |
| VEHICLE: (47.5 ± 2 wt. %) | | | | | | |
| Raw Linseed Oil | 21.0 | — | 10.0 | 16.2 | D 234 | — |
| Alkyd Resin Solids | 41.0 | — | 19.5 | 27.0 | — | TT-R-266, Type I Class A Type II Class B |
| Mineral Spirit Thinner | — | 38.0 | 18.0 | 34.6 | D 235 | — |
| Driers | — | — | — | — | D 600, Non-Lead | — |
| TOTAL VEHICLE: | 100 | | 47.5 | 77.8 | | |
| TOTAL: | | | 100 | 100 | | |

The preblended composite pigment shall comply with the following:

| PROPERTY | METHOD | REQUIRED |
|---|---|---|
| pH | — | 7 to 8 |
| Specific Resistance of Leachate | ASTM D 2448 | 5000 ohm-cm minimum |

*See Note 9.3 for supplier of preblended pigment and Note 9.4 for properties of component pigments.

Provided by : www.spic.ir Licensee: NISOC Library

**3.6 FEDERAL SPECIFICATIONS AND STANDARDS:**

**TT-R-266** Resin, Alkyd: Solutions

**FED-STD-141:** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 3011** | Condition in Container |
| **Method 3021** | Skinning (Partially Filled Container) |
| **Method 4203** | Reducibility and Dilution Stability |
| **Method 4321** | Brushing Properties |
| **Method 4331** | Spraying Properties |
| **Method 4541** | Working Properties and Appearance of Dried Film |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **ANSI Z129.1** | Hazardous Industrial Chemicals —Precautionary Labeling |

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1 for Type I and in Table 2 for Type II.

**4.2** The primer based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. No rosin or rosin derivatives may be used. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added.

**4.3** The paint shall conform to the composition (analysis) requirements of Table 3.

## 5. Properties

**5.1** The primers for Type I and Type II shall meet the requirements of Tables 3 and 4 and of Sections 5.2 through 5.8.

**5.2 ODOR:** The odor shall be normal for the materials permitted (ASTM D 1296).

**TABLE 2**
**COMPOSITION**
**SSPC-Paint 25 BCS, Type II**

| | REQUIRED | | TYPICAL COMPOSITION | | INGREDIENT STANDARDS | |
|---|---|---|---|---|---|---|
| **INGREDIENTS** | **Min. Wt.%** | **Max. Wt. %** | **Wt. %** | **Vol. %** | **ASTM** | **FEDERAL** |
| PIGMENT*: (54.0 ± 2 wt. %) | | | | | | |
| Zinc Oxide | 15.0 | 17.0 | 8.7 | 2.4 | D 79, Dry Pigment, French Process | — |
| Iron Oxide (85% minimum $Fe_2O_3$) | 39.0 | — | 22.1 | 8.5 | D 3722/D 3724 | — |
| Magnesium Silicate | — | 33.0 | 17.8 | 9.9 | D 605 | — |
| Mica | 10.0 | 12.0 | 5.4 | 3.0 | D 607 | — |
| TOTAL PIGMENT: | 100 | | 54.0 | 23.8 | | |
| VEHICLE: (47.5 ± 2 wt. %) | | | | | | |
| Raw Linseed Oil | 22.5 | — | 10.3 | 17.5 | D 234 | — |
| Alkyd Resin Solids | 46.5 | — | 21.4 | 31.0 | — | TT-R-266, Type I Class A Type II Class B |
| Mineral Spirit Thinner | — | 21.0 | 9.7 | 19.4 | D 235 | — |
| High Flash Naphtha | — | 10.0 | 4.6 | 8.3 | D 3734 | — |
| Driers | — | — | — | — | D 600, Non-Lead | — |
| TOTAL VEHICLE: | 100 | | 46.0 | 76.2 | | |
| TOTAL: | | | 100 | 100 | | |

The preblended composite pigment shall comply with the following:

| PROPERTY | METHOD | REQUIRED |
|---|---|---|
| pH | — | 7 to 8 |
| Specific Resistance of Leachate | ASTM D 2448 | 5000 ohm-cm minimum |

*See Note 9.3 for supplier of preblended pigment and Note 9.4 for properties of component pigments.

Provided by : www.spic.ir Licensee: NISOC Library

**5.3 COLOR:** The color shall be typical of the specified mixture of zinc oxide and red or brown iron oxide.

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when two volumes of the paint are slowly mixed with one volume of mineral spirits (FED-STD-141, Method 4203).

**5.5 WORKING PROPERTIES:** The paint shall be easily applied by brush, roller or spray when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging during application or while drying.

**5.6 CONDITION IN CONTAINER:** The paint shall show no thickening, curdling, gelling, or hard caking when tested as specified in FED-STD-141, Method 3011, after storage for six months from the date of delivery, in a full, tightly covered container, at a temperature of 10-43°C (50-110°F).

**5.7 SKINNING:** There shall be no skinning in a three-quarters filled closed container after 48 hours when tested in the standard manner specified in FED-STD-141, Method 3021.

**5.8 SALT CONTAMINATION:** Content of salt contamination shall have been minimized by the incorporation of only high purity materials. The specific resistance of the aqueous leachate of the composite of the pigments in required proportions shall be a minimum of 5,000 ohm-cm when tested in accordance with ASTM D 2448.

## 6. Labeling

**6.1** Refer to ANSI Z129.1,"Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legibly marked with the following information:

Name: Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Blast Cleaned Steel, Type I (or Type II)
Specification: SSPC-Paint 25 BCS
Color: Red or Brown Iron Oxide
Lot Number:
Batch Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
VOC Content:
Manufacturer's Name and Address:

**6.3 PACKAGING:** Material shall be packaged and labeled in accordance with the requirements of ASTM D 3951 unless otherwise specified.

**6.4 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of Zinc Oxide,
Alkyd, Linseed Oil Primer for Use Over
Hand Cleaned Steel

This paint is intended for use as a primer over steel surfaces cleaned at least to SSPC-SP 6, "Commercial Blast Cleaning," or to SSPC-SP 11, "Power Tool Cleaning to Bare Metal" in atmospheric exposure. The surfaces shall be free of all visible oil, grease, dirt, dust, mill scale, rust and paint.

**TABLE 3**
**ANALYSIS**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | REQUIREMENTS Max. Wt. % | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Pigment content | | | | |
| Type I | 50.5 | 54.5 | D 2371 | — |
| Type II | 52.0 | 56.0 | D 2371 | — |
| Volatiles | | | | |
| Type II | — | 18.8 | D 2369 | — |
| Type II | — | 14.9 | D 2369 | — |
| Nonvolatile vehicle | | | | |
| Type II | 28.2 | — | D 2832 | — |
| Type II | 30.4 | — | D 2832 | — |
| Uncombined water | — | 1.0 | D 1208 | — |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 1.5 | D 185 | — |
| Rosin or rosin derivatives | — | 0 | D 1542 | — |

Provided by : www.spic.ir Licensee: NISOC Library

Mix paint thoroughly before use. If the pigment has settled, pour off most of the liquid. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring the contents to a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

The thinning of paint may change the VOC class. For roller, brush, or airless spray application, no thinning should be necessary. A minimum amount of thinning may be necessary for conventional air spray.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 50 micrometers (2 mils) dry. The surface to be painted shall be dry; the surface temperature shall be at least 3 C° (5 F°) above the dew point and the temperature of the air shall be over 4°C (40°F). Do not paint outdoors in rainy weather or if freezing temperatures are expected before the paint dries.

Allow paint at least 18 hours drying time before recoating.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified therein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not a requirement of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**TABLE 4**
**PROPERTIES**

| | REQUIREMENTS | | | |
|---|---|---|---|---|
| **CHARACTERISTICS** | **Min.** | **Max.** | **ASTM** | **FED-STD-141** |
| Consistency* shear rate 200 rpm | | | | |
| Grams | 225 | 300 | D 562 | — |
| Krebs units | 86 | 95 | D 562 | — |
| Density, kg/L (lb/US gal) | | | | |
| Type I | 1.50 (12.5) | — | D 1475 | — |
| Type II | 1.56 (13.0) | — | D 1475 | — |
| Fineness of grind, Hegman units | 3.0 | — | D 1210 | — |
| Drying time, hours | | | | |
| Tack free | — | 6 | D 1640 | — |
| Dry hard | — | 18 | D 1640 | — |
| Flash point, °C (°F) | 38 (100) | — | D 3278 | — |
| Sag resistance, mm (mils) | 0.18 (7) | 0.25 (10) | D 4400 | — |

*Consistency 48 hours or more after manufacture

Provided by : www.spic.ir Licensee: NISOC Library

**9.2** The extraction of chlorides and other anions from corrosion pits in severe corrosivity areas of the structure is recommended.

**9.3** The preblended composite pigment can be obtained from Hoover Color Corporation, P. O. Box 218, Hiwasse, VA 24347; Phone (703) 980-7233.

**9.4** During the development of SSPC-Paint 25, the purity of each pigment was measured in accordance with ASTM D 2448. The specific resistances of the leachate for the individual pigments were as follows:

French process zinc oxide ..... 20,000 ohm-cm
Iron oxide .....5,000 ohm-cm
Magnesium silicate .....2,800 ohm-cm
Mica ..... 17,000 ohm-cm

The calculated resistance for the formula blend using these purities for the individual paints is 5000 ohm-cm.

**9.5** Handle wastes in accordance with federal, state and local government regulations. See SSPC-Guide 7, "Guide for the Disposal of Lead-Contaminated Surface Preparation Debris."

**9.6** The degrees of surface preparation SSPC-SP 5/NACE No. 1 and SSPC-SP 10/NACE No. 2 are better than SSPC-SP 6/NACE No. 3 and SSPC-SP 11.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 26
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 26

## Slow Drying Linseed Oil Black Maintenance Primer (Without Lead and Chromate Pigments)

### 1. Scope

**1.1** This specification covers a very slow drying black, one-coat, raw linseed oil maintenance primer for steel. It has fair rust inhibitive characteristics, good wetting ability, a drying time of about one week, and good resistance to weathering without field coating.

**1.2** This primer is suitable for exposures in Environmental Zones 1A (interior, normally dry) and 1B (exterior, normally dry), and is intended for brush and spray application over steel surfaces prepared in accordance with SSPC-SP 2, "Hand Tool Cleaning." The performance will be improved by a better degree of surface preparation. It is suitable as a maintenance primer and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel." It is not ever used as a shopcoat for steel because of its very long drying time. It is unsuitable for use where the uncured, slippery paint film would be dangerous to workmen when walking or climbing on painted surfaces.

**1.3** This specification is based on Patent No. 2,858,285 which was assigned to the DuPont Company in 1959.

### 2. Description

**2.1** The good wetting ability of this primer is the result of its high proportion of raw linseed oil. Details of the composition are given in Table 1.

**2.2** This primer contains approximately 87% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 4.0 mil (102 micrometers) dry film thickness is 350 square feet/U.S. gallon (8.6 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **SP 2** | Hand Tool Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 79** | Specification for Zinc Oxide Pigments |
| **D 185** | Test Methods for Coarse Particles in Pigments, Pastes, and Paints |
| **D 209** | Specification for Lampblack Pigment |
| **D 234** | Specification for Raw Linseed Oil |
| **D 235** | Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent) |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 600** | Specification for Liquid Paint Driers |
| **D 605** | Specification for Magnesium Silicate Pigment (Talc) |
| **D 1208** | Test Methods for Common Properties of Certain Pigments |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1542** | Test Method for Qualitative Detection of Rosin in Varnishes |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 2371** | Test Method for Pigment Content of Solvent-Reducible Paints |
| **D 2801** | (Canceled) Test Method for Leveling Characteristics of Paints by Draw-Down Method (Refer to ASTM D 4400) |
| **D 3278** | Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**COMPOSITION**

| INGREDIENTS | REQUIRED Min. Wt. % | REQUIRED Max. Wt. % | TYPICAL COMPOSTITION Wt. % | TYPICAL COMPOSTITION Vol. % | INGREDIENT STANDARDS ASTM | INGREDIENT STANDARDS FEDERAL |
|---|---|---|---|---|---|---|
| PIGMENT: (54 ± 2 wt. %) | | | | | | |
| Zinc Oxide, French Process | 15 | 17 | 8.0 | — | D 79, Type I | — |
| Barium Lanolate | 3 | 5 | 2.7 | — | — | — |
| Magnesium Silicate | — | 75 | 40.5 | — | D 605 | — |
| Lampblack | — | 5 | 2.6 | — | D 209 | — |
| VEHICLE: (46 ± 2 wt. %) | | | | | | |
| Raw Linseed Oil | 64 | — | 29.3 | — | D 234 | — |
| Alkyd Resin Solids | 16 | — | 7.4 | — | — | TT-R-266, Type II |
| Mineral Spirit Thinner | — | 20 | 9.5 | — | D 235 | — |
| Driers | — | — | — | — | D 600, Class B | — |
| TOTALS | | | 100.0 | | | |

**D 4400** Test Method for Sag Resistance of Paints Using Multinotch Applicator

**3.6 FEDERAL STANDARDS:**

**3.6.1 Standard Specifications for Ingredients:**

**TT-R-266** Resin, Alkyd: Solutions

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

**Method 3011** Condition in Container
**Method 3021** Skinning (Partially Filled Container)
**Method 4021** Pigment Content (Ordinary Centrifuge)
**Method 4053** Nonvolatile Vehicle Content
**Method 4061** Drying Time
**Method 4203** Reducibility and Dilution Stability
**Method 4321** Brushing Properties
**Method 4331** Spraying Properties
**Method 4541** Working Properties and Appearance of Dried Film

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

**Z129.1** Hazardous Industrial Chemicals—Precautionary Labeling

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1.

**4.2** The primer based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. No rosin or rosin derivatives may be used. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added.

**4.3** The paint shall conform to the composition (analysis) requirements of Table 2.

## 5. Properties

**5.1** The paint shall meet the requirements of Table 3 and Sections 5.2 through 5.7.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**5.3 COLOR:** The color shall be typical of the specific mixture of zinc oxide and carbon black.

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when two volumes of the paint are slowly mixed with one volume of mineral spirits (FED-STD-141, Method 4203).

**5.5 WORKING PROPERTIES:** The paint shall be easily applied by all three methods when tested in accordance

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**ANALYSIS**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | Max. Wt.% | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Pigment | 52 | 56 | D 2371 | 4021 |
| Volatiles | — | 6 | D 2369 | — |
| Nonvolatile vehicle calculated by difference | 42 | — | — | 4053 |
| Uncombined water | — | 1.0 | D 1208 | — |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 1.5 | D 185 | — |
| Rosin or rosin derivatives | — | 0 | D 1542 | — |

**TABLE 3**
**PROPERTIES**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Viscosity* shear rate 200 rpm | | | | |
| Grams | 150 | 250 | D 562 | — |
| Kreb units | 72 | 89 | D 562 | — |
| Weight per U.S. gallon, pounds | 12.2 (1.5 kg/L) | — | D 1475 | — |
| Fineness of grind, Hegman units | 3.0 | — | D 1210 | — |
| Drying time, hours | | | | |
| Tack free | — | 24 | — | 4061 |
| Dry hard | — | 168 | — | 4061 |
| Flash Point, degrees F | 100 (38˚C) | — | D 3278 | — |
| Sag Resistance, mils | 6 (150 micrometers) | — | D 2801** | |

*Viscosity 48 hours or more after manufacture.
**ASTM D 2801 has been replaced by ASTM D 4400.

with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging after drying.

**5.6 CONDITION IN CONTAINER:** The paint shall show no thickening, curdling, gelling, or hard caking when tested as specified in FED-STD-141, Method 3011, after storage for six months from the date of delivery, in a full, tightly covered container, at a temperature of 50-110°F (10-43°C).

**5.7 SKINNING:** There shall be no skinning in a threequarters filled closed container after 48 hours when tested in the standard manner specified in FED-STD-141, Method 3021.

## 6. Labeling

**6.1** Refer to ANSI Z129.1 "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legibly marked with the following information:

Name: Slow Drying Linseed Oil Black Primer
Specification: SSPC-Paint 26
Color: Black
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

Provided by : www.spic.ir Licensee: NISOC Library

**6.3 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of Slow Drying Linseed Oil Maintenance Primer and Alkyd Primer

This paint is intended for use as a primer over hand cleaned steel in atmospheric exposure; it will perform better if the steel is power tool cleaned, blast cleaned, or pickled. All rust scale, loose rust, loose mill scale, and loose or nonadherent paint shall be removed; oil and grease shall be removed to the fullest extent practical, as residues of oil and grease remaining on the surface will result in decreased paint performance.

Mix paint thoroughly before use. If the pigment has settled, pour off most of the liquid. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring contents to a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

Thin paint only if necessary, using only mineral spirits. For brush application under normal conditions, no thinning should be necessary. For spray applications, add up to one pint of thinner per gallon (120 ml/L) of paint when necessary.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 4 mils (100 micrometers) dry or approximately 4.1 mils (104 micrometers) wet. The surface to be painted shall be dry; the surface temperature shall be at least 5°F (3°C) above the dew point and the temperature of the air shall be over 40°F (4°C). Do not paint outdoors in rainy weather or if freezing temperatures are expected before the paint dries.

Allow paint at least one week drying time in good weather before recoating.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 27
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 27

## Basic Zinc Chromate-Vinyl Butyral Wash Primer*

### 1. Scope

**1.1** This specification covers a two-component basic zinc chromate-vinyl butyral wash primer for structural steel surfaces prior to painting.

**1.2** It is intended that this coating be used primarily on clean steel free of rust and scale or on clean galvanized metal cleaned according to SSPC-SP 1, "Solvent Cleaning"; but it may be used, when specified, on steel with very slight amounts of rust. It is to be applied by brush or spray in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

### 2. Description

**2.1** Basic zinc chromate-vinyl butyral wash primer is a pretreatment for metals which reacts with the metal and at the same time forms a protective vinyl film which contains an inhibitive pigment to help prevent rusting. This coating is supplied as two components which are mixed together just prior to use. The base contains an alcohol solution of polyvinyl butyral resin pigmented with basic zinc chromate. The diluent contains an alcohol solution of phosphoric acid which reacts with the vinyl resin, the pigment, and the steel. Details of the composition are given in Federal Specification DoD-P-15328.

**2.2** This primer contains approximately 10% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 0.5 mil (13 micrometers) dry film thickness is 320 square feet/U.S. gallon (7.9 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **SP 1** | Solvent Cleaning |

**3.5 ASTM STANDARD:**

| | |
|---|---|
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL STANDARD:**

| | |
|---|---|
| **DoD-P-15328** | Primer (Wash), Pretreatment (Formula No. 117 for Metals) |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD.**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals—Precautionary Labeling |

### 4. Composition

**4.1** Ingredients, proportions, and analysis shall be as specified in Federal Specification DoD-P-15328.

### 5. Properties

**5.1** The paint shall meet the requirements of Federal Specification DoD-P-15328.

### 6. Labeling

**6.1** Refer to ANSI Standard Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container of each component shall be legibly marked with the following information:

Name: Basic Zinc Chromate-Vinyl Butyral Wash Primer
Specification: SSPC-Paint 27
Component:
Lot Number:
Stock Number:
Date of Manufacture:

Provided by : www.spic.ir Licensee: NISOC Library

Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions use shall be supplied with each container of paint:

Directions for Use of Basic Zinc Chromate-Vinyl Butyral Wash Primer

This paint is intended to be used primarily on clean steel free of rust and scale or on clean galvanized metal; but it may be used, when specified, on steel with very slight amounts of rust bloom.

Four volumes of base shall be mixed with one volume of diluent as follows: first, break up the pigment settled in the base with a wooden paddle, mechanical stirrer, or mixer, and mix to distribute the pigment evenly throughout the base. After the base is thoroughly mixed, slowly pour one volume of the diluent into four volumes of the base with constant agitation. Do not pour off the liquid which has separated from the pigment and then add the diluent to the settled pigment to aid mixing. Material which is not mixed properly may gel and be unfit for use. The base shall be mixed with the diluent in quantities which will be applied within six to eight hours after mixing. Primer that cannot be used within a maximum of eight hours after mixing with diluent shall be discarded and not used. Screen paint before applying.

Apply the wash primer by spraying or brushing. Spraying is generally the preferred method, but brushing may be desirable over rough or poorly prepared steel. Roller coating may be used only if specified. Paint brushes should be clean and dry, or wetted with alcoholic solvents. When sprayed, the primer must be deposited on the surface wet; if dusting is encountered, move the gun closer to the surface; if already within six inches (15 cm) of the surface, decrease atomizing air pressure or increase the liquid pressure, or add thinner.

Where thinning is desired isopropanol (99% grade) or butanol (normal butyl alcohol) or denatured ethanol should be used. At least 25% thinning is usually necessary to get a uniform application. Use denatured ethyl or isopropyl alcohol to clean equipment.

Apply to a dried film thickness of 0.3 to 0.5 mils (8 to 13 micrometers) dry or approximately 3 to 5 mils (75 to 125 micrometers) wet. Note that at this thickness, which should not be exceeded, the base metal will show through the coating as evidenced by uneven coloring. This is the normal appearance; do not attempt to hide the base metal completely.

When spot treating, cover only spots free of old paint. Slight overlap of existing paints is generally not harmful provided adherence of the wash primer to the old paint is satisfactory and the old paint is not lifted.

The next coat of paint may be applied as soon as the wash primer is dry, usually from one half hour to four hours later, except when otherwise authorized by the inspector.

This wash primer should be applied over clean, dry steel; however, a slightly damp surface may be painted over, provided adequate normal butyl alcohol is used in the thinner. If the surface is excessively wet, the vinyl butyral resin will be thrown out of solution and form a gel, or the dried film will turn white, become brittle, and lack adhesion to the steel.

This wash primer is not intended for use as a shop coat for steel, and it should be recoated with the prime coat of paint before exposure, preferably within 24 hours.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

Provided by : www.spic.ir Licensee: NISOC Library

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**9.2** This wash primer is intended for use over clean, dry, descaled steel. It does not work over phosphate treated steel, and should not be used over paint or wetting oils. It must be used on bare metal for best results. If used over mill scale, it may contribute to mill scale lifting.

**9.3** This wash primer may be used to bond conventional paints to galvanized surfaces or stainless steel. Solvent cleaning of such surfaces, even though apparently clean, is advisable before applying the wash primer. Adhesion to some types of white rust preventives on galvanized steel is poor.

**9.4** Almost all paints will adhere well to this wash primer; exceptions are certain types of vinyl paints and some lacquers; these coatings may require an intermediate or bonding coat. Paints containing alcohol or ketone solvents generally show best bonding.

*This paint contains chromate pigments. Users are urged to follow all health, safety, and environmental requirements in applying, handling, and disposing of these materials.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 28

## Water-Borne Epoxy Primer for Steel Surfaces

### 1. Scope

**1.1** This specification covers an ambient temperature curing, two-component water-borne epoxy coating for steel that is intended for use as a primer of a multicoat water-borne epoxy or other coating system.

**1.2** Primer coatings are categorized according to performance levels (Sections 2.3, 6, and 7).

**1.3** Properly topcoated primers meeting this specification are suitable for exposures in Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water), 2B (frequently wet by salt water) and 3C (chemical exposure, alkaline).

**1.4** The specified primer is intended for application by brush, spray, or roller over steel surfaces prepared in accordance with the manufacturer's recommendations. It is suitable as a shop primer, field primer, maintenance primer, or intermediate coat and is to be applied in accordance with SSPC-PA 1. Manufacturer's recommendations should be followed when the primed steel is to be weathered prior to topcoating.

### 2. Description

**2.1 COMPOSITION:**

**2.1.1** The primer specified is typically based on a reactive oxirane (epoxy) functional resin with amine or acid functional curing agents (see Section 4.1).

**2.1.2** The major volatile component by weight is water. Refer to ASTM D 3792 or ASTM D 4017 for determining water content of paints.

**2.2 VOC LEVEL:** The specified primer may or may not comply with all air pollution regulations. Consult applicable government regulations to determine maximum allowable volatile organic compounds (VOC) and proper VOC test method for a particular application. Supplier should provide VOC information on the coating as supplied (in the container) and as applied (in the field after recommended thinning). See Notes 12.2 and 12.3.

**2.3 PERFORMANCE LEVEL:** Primers shall be classified according to the exposure performance achieved as follows based on testing of two coats of primer:

**Level 1:** Accelerated Testing (Section 6)
**Level 2:** Exterior Exposure (Section 7)

**2.3.1** If no performance level is specified, Level 2 is assumed.

### 3. Reference Standards

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

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

**3.3 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness with Magnetic Gages |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |
| **VIS 2** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |

**3.4 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **A 569** | Specification for Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality |
| **B 117** | Practice for Operating Salt Spray (Fog) Apparatus |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 609** | Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products |
| **D 610** | Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces |
| **D 714** | Test Method for Evaluating Degree of Blistering of Paints |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1654** | Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments |
| **D 1849** | Test Method for Package Stability of Paint |
| **D 2243** | Test Method for Freeze-Thaw Resistance of Water-Borne Coatings |
| **D 2247** | Practice for Testing Water Resistance of Coatings in 100% Relative Humidity |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 2574** | Test Method for Resistance of Emulsion Paints in the Container to Attack by Microorganisms |
| **D 3363** | Test Method for Film Hardness by Pencil Test |
| **D 3792** | Test Method for Water Content of Water-Reducible Paints by Direct Injection into a Gas Chromatograph |
| **D 3924** | Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |
| **D 3960** | Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings |
| **D 4017** | Test Method for Water in Paints and Paint Materials by Karl Fischer Method |
| **D 4417** | Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel |
| **D 4585** | Practice for Testing the Water Resistance of Coatings Using Controlled Condensation |
| **G 92** | Practice for Characteristization of Atmospheric Test Sites |

**3.5 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals—Precautionary Labeling of |

**3.6 FEDERAL STANDARD:**

**40 CFR 60, Appendix A, Method 24**—Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings

## 4. Composition

**4.1** The manufacturer is given latitude in the selection of materials and process of manufacture, provided that the paint meets the requirements of this specification.

## 5. Standard Testing Conditions

**5.1** The standard testing conditions shall be in accordance with the standard atmosphere in ASTM D 3924, unless indicated otherwise. Standard temperature shall be 73.5 ± 3.5°F (23 ± 2°C) and standard relative humidity 50 ± 5%.

**5.2** The standard substrate shall be 1/8"(3.2 mm) thick ASTM A 569 hot rolled steel abrasive blasted in accordance with SSPC-SP 10 to a profile of 2.0 ± 0.5 mils (50 ± 13 micrometers) unless indicated otherwise. Measure blast profile in accordance with ASTM D 4417.

**5.3** The standard dry film thickness of the primer shall be 2.5 ± 0.5 mils (64 ± 13 micrometers) per coat unless indicated otherwise. Measure dry film thickness in accordance with SSPC-PA 2.

## 6. Laboratory Performance Testing Requirements

**6.1** For Level 1, the paint shall meet the requirements of Sections 6.2 through 6.13. For Level 2, the paint shall meet the requirements of Sections 6.2 through 6.13 and Sections 7.1 and 7.2.

**6.2 RESISTANCE TO MICROORGANISMS IN CONTAINER:** The paint shall be resistant to attack by microorganisms when tested according to ASTM D 2574.

**6.3 FREEZE-THAW RESISTANCE:** Test each of the components separately in accordance with ASTM D 2243. At the end of three cycles there shall be no gelling or excessive thickening, coagulation, lumps or coarse panicles. The maximum allowable increase or decrease in viscosity shall not exceed 10 Krebs units.

**6.4 PACKAGE STABILITY:** Perform the following tests in accordance with ASTM D 562. Place each component in closed containers in an oven for one month at 25 ± 2°F (52 ± 1°C). The maximum allowable increase or decrease in viscosity shall not exceed 10 Krebs Units. After brushing out, the film shall be free from grains, lumps, or streaks.

**6.5 MECHANICAL STABILITY:** Test each component separately by filling a one-quart friction top can three-quarters full and closing the can tightly. Rotate on a jar roller for one week at 120 to 170 rpm. At the end of one week, there shall be no indication of separation, coagulation, excessive thickening or loss in mechanical stability. The maximum allowable increase or decrease in viscosity shall not exceed ten Krebs Units when tested according to ASTM D 562.

Provided by : www.spic.ir Licensee: NISOC Library

**6.6 POT LIFE:** The term pot life, as used for solvent-borne or solventless epoxies, generally does not have the same meaning for water-borne epoxies. The usable life of mixed components of water-borne epoxies cannot be determined simply by measuring changes in viscosity. To determine usable pot life of water-borne epoxies, thoroughly mix together both components of the primer to yield one quart of mixed primer. Allow the mixed primer to stand at standard conditions under Section 5.1 for the pot life time specified by the manufacturer. At the end of this time period, the mixed primer shall show no evidence of gellation and must meet the requirements of Sections 6.7, 6.8, 6.10, 6.11, and 6.13.

**6.7 LABORATORY APPLICATION PROPERTIES:** Thoroughly mix together both components of the primer. Allow mixed primer to stand for manufacturer's specified induction time (if any). Apply (brush, roll, or spray) the primer in accordance with the manufacturer's recommendations to a vertical steel substrate under the standard conditions specified in Sections 5.1, 5.2, and 5.3. Allow to dry in a well-ventilated room or chamber free from drafts and dust in diffuse light (not in direct sunlight). There shall be no runs, sags, streaks, flashes, laps, pinholing, eyeing, or cratering.

**6.8 ADHESION:** Condition a primed panel for seven days at standard temperature and humidity (Section 5.1). Evaluate adhesion in accordance with ASTM D 3359 Method B, "Cross Cut Tape Test" using one mm spacing of cuts. A rating of 5B is required.

**6.9 RECOAT TESTS:** Apply a second coat following the manufacturer's recommendations. There shall be no picking-up or rolling-up of the first coat during applications. After 24 hours, the film shall be smooth and uniform.

**6.10 FILM IRREGULARITY:** Apply one coat of the primer by the drawdown method to a 4 inch x 8 inch (10 cm x 20 cm) cold-rolled steel panel to produce the standard dry film thickness (Section 5.3). Allow to dry for 24 hours in accordance with the standard testing conditions specified in Sections 5.1. Examine the film for mud-cracking, alligatoring, or other film irregularity; there shall be none.

**6.11 RUST AND BLISTER RESISTANCE:** Spray apply two coats (allowing 24 hours drying time between coats) to four panels in accordance with the standard testing conditions specified in Sections 5.1, 5.2, and 5.3. Allow to dry for seven days after application of the second coat. Coat and seal all edges and the back side of each panel with a coating that will provide the necessary protection to these surfaces.

Scribe a two-inch (five cm) vertical line through the lower middle portion of the primed panels so as to expose the underlying metal before testing. The conditions of making the scribe shall be as described in ASTM D 1654.

**6.11.1 SALT SPRAY**: Expose duplicate panels in the salt fog cabinet for 600 hours according to ASTM B 117. At the end of 600 hours, immediately examine for rusting and blistering. The rusting shall not exceed 8 according to SSPC-VIS 2 or ASTM D 610, and the blistering shall not exceed 8F according to ASTM D 714. After examining the panels for blistering, immediately remove the paint film with a suitable organic solvent, for example chlorinated hydrocarbon or other solvent recommended by the paint manufacturer. If scraping of the paint film is necessary to remove it, do not use a metal spatula or razor blade. Use a piece of soft wood. Examine the steel substrate. The rusting shall not exceed 8 as judged by SSPC-VIS 2 or ASTM D 610. The rust creep, as judged by the bare panel, shall not exceed 1/8 inch (3.2 mm) from the center of the scribe.

**6.11.2 CONDENSATION:** Expose the other pair of duplicate panels in a condensing cabinet according to ASTM D 4585 for 500 hours at 100°F (38°C). At the end of 500 hours, immediately examine for rusting and blistering. The rusting shall not exceed 8 according to SSPC-VIS 2 or ASTM D 610, and the blistering shall not exceed 8F according to ASTM D 714. After examining the panels for blistering, immediately remove the paint film with a suitable organic solvent. If scraping of the paint film is necessary to remove it, do not use a metal spatula or razor blade. Use a piece of soft wood. Examine the steel substrate. The rusting shall not exceed 9 as judged by SSPC-VIS 2 or ASTM D 610. The rust creep, as judged by the bare panel, shall not exceed 1/8 inch (3.2 mm) from the center of the scribe.

**6.12 FLASH RUST RESISTANCE TEST:** Apply one coat of the paint in accordance with the standard testing conditions specified in Sections 5.1, 5.2, and 5.3 and allow to dry in a horizontal position for 24 hours. At the end of the drying period, examine for flash rusting or rust bleeding. The paint shall show no rust bleed-through. After examining the panel for rust bleed-through, immediately remove the paint film with a suitable organic solvent. If scraping of the paint film is necessary to remove it, do not use a metal spatula or razor blade. Use a piece of soft wood. Examine the steel substrate. There shall be no rusting of the steel substrate.

**6.13 EARLY WATER RESISTANCE:** Apply one coat of the primer in accordance with the standard testing conditions specified in Sections 5.1, 5.2, and 5.3. After six hours of drying, immerse one half of the panel into distilled water for five minutes. Remove and allow to condition for ten minutes at standard temperature (Section 5.1). The section exposed to the water shall have the same hardness as the unexposed section when checked with either the fingernail or ASTM D 3363 pencil hardness.

Provided by : www.spic.ir Licensee: NISOC Library

## 7. Test Fence Performance Requirements

**7.1** Triplicate panels shall be prepared as described in Section 6.11 except that the coating thickness shall be 3.5 ± 1.0 mils (89 ± 25 micrometers) as measured by SSPC-PA 2.

**7.2 EXTERIOR EXPOSURE:** Triplicate test specimens shall be exposed for a minimum of 18 months on a test fence at an industrial or marine exposure site having a minimum annual mean precipitation of 25 inches (635 mm) per year. Other criteria for classifying the environment such as corrosion rate of bare steel or bare zinc (in accordance with ASTM G 92), or mean annual temperature may also be required when agreed to between contracting parties. Each specimen shall meet the following requirements (Note 12.4):

- Minimum rust rating of 9 in accordance with SSPC-VIS 2/ASTM D 610
- Maximum scribe undercutting of 1/16 inch (1.6 mm)

## 8. Material Quality Assurance

**8.1** The manufacturer should measure and record batch testing information that would allow certification that a batch meets the necessary standards established by the manufacturer for the primer as tested per Section 6.

**8.2 CONDITION IN CONTAINER:** Each component as received shall show no evidence of livering, skinning, or hard settling of the pigment. The inside of the container shall not be corroded. The material shall be easily dispersed in the liquid portion by hand stirring to form a smooth, homogeneous paint.

**8.3 COLOR:** The color shall be as specified in the procurement documents.

**8.4 POT LIFE:** Mix the primer as specified in Section 6.6. Allow the mixed primer to stand at standard conditions (Section 5.1) for the pot life specified by the manufacturer. At the end of this time period, the mixed primer shall show no evidence of gelation.

**8.5 VISCOSITY:** The viscosity of the mixed primer shall be determined in accordance with ASTM D 62. Variance shall be within ± 5 Krebs units or equivalent units of another viscometer of the viscosity of the previously qualified primer.

For viscosities lower than 55 KU, a number 4 Ford Cup shall be used in accordance with ASTM D 1200. Variations shall be within ± 5 seconds of the viscosity of the previously qualified paint.

**8.6 DENSITY:** The density of the mixed primer shall be determined in accordance with ASTM D 1475. Variance shall be within ± 0.4 pounds per gallon (50 g/L) of the nominal density of the previously qualified primer.

**8.7 SOLIDS BY WEIGHT:** Solids by weight of the mixed primer shall be determined in accordance with ASTM D 2369. Variance shall be within ± 2% of the nominal percent solids by weight of the previously qualified primer (Note 12.5).

## 9. Labeling

**9.1** Refer to ANSI Z129.1. Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**9.2 MARKING OF CONTAINERS:** Each container of each component shall be legibly marked with the following information:

Name: Water-Borne Epoxy Primer
Specification: SSPC-Paint 28
Component:
Color:
Lot Number:
Batch Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**9.3 DIRECTIONS FOR USE:** Directions for use of water-borne epoxy primer must include information on storage, surface preparation, mixing, thinning, application, and recoatability.

## 10. Inspection

**10.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 12.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**10.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase

Provided by : www.spic.ir Licensee: NISOC Library

order is placed or may be taken from unopened containers at the job site.

**10.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 11. Disclaimer

**11.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**11.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 12. Notes

Notes are not requirements of this specification.

**12.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**12 .2** VOC information may be supplied on the label or the technical data sheet.

**12.3** ASTM D 3960 and EPA Method 24 are commonly used methods to determine VOC, but these methods may not be acceptable to all jurisdictions.

**12.4** The 250 meter lot (800 ft lot) at the LaQue Center, Wrightsville (Kure) Beach, NC and the Neville Island and coke works sites in Pittsburgh, PA with average bare steel corrosion rates of one to three mils (25 to 75 micrometers) per year based on panels exposed for 12 months, have been shown suitable for this specification's exterior exposure. The test coatings used to establish the performance requirement were evaluated at these test sites.

**12.5** The supplier should also furnish information on the volume solids and the theoretical spreading rate (square feet per gallon for one mil of dry paint) [square meters per liter for one micrometer of dry paint].

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 29
August 1, 1991
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 29

## Zinc Dust Sacrificial Primer, Performance-Based

### 1. Scope

**1.1** This specification covers highly pigmented primers that contain zinc dust as the major pigment component (minimum 50% by weight in the dry film) and are defined by their ability to galvanically protect ferrous substrates.

**1.2** The vehicle type may be inorganic (Type I) or organic (Type II).

**1.3** Each primer type (I and II) is classified according to the level of exterior performance at a severe marine site. Laboratory performance criteria are also included.

**1.4** This specification does not cover weldable preconstruction primers.

**1.5** This primer, when applied over properly prepared steel substrates, can provide effective corrosion resistance in a wide range of environmental zones (see Note 11.1). In some cases a topcoat may be required.

### 2. Description

**2.1 USE OF SPECIFICATION:**

**2.1.1** Primers meeting these specifications are categorized according to vehicle type, and performance level.

**2.1.2** If no vehicle type is specified, either Type I, inorganic, or Type II, organic, is acceptable (see Section 2.5).

**2.1.3** If no performance level is specified, Level 1 is assumed (see Section 2.8).

**2.2 COMPOSITION:** The coatings described in this specification consist of zinc dust, functional additives, and an organic or inorganic binder, with appropriate solvents.

**2.3 SELECTION OF PRIMER:** The selection and use of these primers are given in SSPC-PS Guide 12.00 and SSPC- PS 12.01. An exception to these guides regards zinc dust loading.

**2.4 PIGMENTATION**

**2.4.1** The major pigment component in these coatings is zinc dust of the type described in ASTM D 520.

**2.4.2** Other pigment components may include extenders, curing aids, tinting colors, suspension and pot life control agents.

**2.5 VEHICLE TYPES:** The vehicles used for these coatings may be as follows:

**Type I:** inorganic; solvent or water reducible; self or post cure

**Type II:** organic; solvent or water reducible

**2.6 VOLATILE ORGANIC COMPOUND (VOC) CONTENT:** The VOC content of the primer shall be determined from the coating as applied, after recommended thinning.

**2.7 COMPONENTS:** These zinc-dust primers may consist of one, two, or three components.

**2.8 EXTERIOR PERFORMANCE:** The primer shall be classified as follows according to the minimum number of months of successful performance at a severe marine site (see Section 6.5):

**Type I**: Inorganic Zinc Primer
**Level 1:** 12 months
**Level 2:** 30 months

**Type II:** Organic Zinc Primer
**Level 1:** 12 months
**Level 2:** 30 months

### 3. Reference Standards

**3.1** The documents and standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

**3.3** If there is a conflict between the requirements of any of the cited reference documents and this specification, the requirements of this specification shall prevail.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **PS 12.01** | One-Coat Zinc-Rich Painting System |
| **PS Guide 12.00** | Guide to Zinc-Rich Coating Systems |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **VIS 2** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **A 569** | Specification for Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality |
| **B 117** | Practice for Operating Salt Spray (Fog) Apparatus |
| **D 185** | Test Methods for Coarse Particles in Pigments, Pastes, and Paints |
| **D 520** | Specification for Zinc Dust Pigment |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 610** | Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces |
| **D 714** | Test Method for Evaluating Degree of Blistering of Paints |
| **D 1200** | Test Method for Viscosity by Ford Viscosity Cup |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1654** | Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments |
| **D 2196** | Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield) Viscometer |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 3359** | Test Methods for Measuring Adhesion by Tape Test |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |
| **D 3951** | Practice for Commercial Packaging |
| **D 3960** | Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings |
| **D 4417** | Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel |
| **G 23** | (Canceled) Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials [Replace with appropriate cycle of G 151 to G 155.] |
| **G 26** | (Canceled) Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials [Replace with appropriate cycle of G 151 to G 155.] |
| **G 53** | (Canceled) Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials [Replace with appropriate cycle of G 151 to G 155.] |
| **G 92** | Practice for Characteristization of Atmospheric Test Sites |

**3.6 FEDERAL STANDARDS:**

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 4331** | Spraying Properties |
| **Method 4541** | Working Properties and Appearance of Dried Film |

**40 CFR 60, Appendix A, Method 24**—Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals—Precautionary Labeling |

## 4. Composition

**4.1 ZINC DUST:** The paint shall contain a minimum 50% zinc dust pigment by weight in the dry film.

**4.2 VOLATILE ORGANIC COMPOUND (VOC) CONTENT:** The manufacturer shall designate the VOC content as determined in accordance with the method required in the jurisdiction where the coating is to be applied. If no method is specified, use EPA Method 24 (see Note 11.2). The VOC content requirement shall be specified by the purchaser.

## 5. Qualitative Requirements

**5.1** The paint shall meet the qualitative requirements Sections 5.2 through 5.6.

**5.2 MIXING:** The components of the liquid portion of either the inorganic or organic multicomponent paints shall be mixed and dispersed as required to produce a product which is uniform, stable, free from grit, and conforms to the requirements of this specification. The pigment portion of

Provided by : www.spic.ir Licensee: NISOC Library

multicomponent paints, prior to mixing, shall be dry and loosely packed.

The ready-mixed paint shall be capable of being broken up with a paddle to a smooth, uniform consistency and shall not liver, thicken, curdle, gel, hard settle, or show any other objectionable properties in a mixed, freshly opened container.

After mixing, all types of coarse particles and skins as residue retained on a standard 60 mesh screen shall be no more than 0.5% by weight of total paint, regardless of type, in accordance with ASTM D 185. If required for new technology coatings, an alternate screen size may be agreed to among contracting parties.

**5.3 POT LIFE:** The pot life of all zinc dust coatings will vary with individual formulations and temperatures (being less at higher temperature and solids). The pot life should be sufficient for a given application. The supplier and purchaser should agree on the pot life requirement and method to monitor usable pot life.

**5.4 STORAGE LIFE:** Neither the vehicle of the multicomponent paint nor the ready-mixed paint shall show thickening that is detrimental to performance or application properties. The components or paint shall exhibit no curdling, gelling, gassing, or hard caking after being stored unmixed for a minimum of six months from date of delivery in a tightly covered unopened container at a temperature of 50 to 90°F (10 to 32°C). If extended storage life is required, the supplier and end user must agree to the time limits in question.

**5.5 WORKING PROPERTIES:** The mixed paint shall spray easily, and show no overspray, streaking, running, sagging or other objectionable features when applied at coating manufacturer's recommended film thickness and tested in accordance with FED-STD-141, Methods 4331 and 4541.

**5.6 MUDCRACKING:** The coating when applied in accordance with Section 6.2 to a five to six mil (127 to 153 micrometers) dry film thickness, shall show no mudcracking when viewed by the unaided eye.

## 6. Performance Testing Requirements

**6.1 REQUIREMENTS:**

**6.1.1** The coated specimens, when prepared and aged in accordance with Section 6.2, shall meet the requirements of Sections 6.3 and 6.4.

**6.1.2** Coatings shall be exposed in accordance with Section 6.5.1. Coatings meeting requirements of Section 6.5.2.1 (for Type I) or Section 6.5.2.2 (for Type II) shall be designated as Level 1. Coatings meeting requirement of Section 6.5.3.1 (for Type I) or Section 6.5.3.2 (for Type II)) shall be designated as Level 2.

**6.1.3** These requirements are summarized in Table 1.

**6.2 TEST PANEL PREPARATION:**

**6.2.1** Steel test panels (ASTM A 569 or equivalent hot rolled steel), measuring 3 inch x 6 inch x 1/16 inch (75 x 150 x 1.6 mm) or greater, shall be white metal blast cleaned (SSPC-SP 5) with the type of blast media being clearly identified. The panels shall have a nominal anchor profile of 1.0 to 2.5 mils (25 to 64 micrometers), then coated with the test paint. The profile shall be measured according to ASTM D 4417. The panels shall be blast cleaned and coated on both sides and all edges. The paint shall be spray-applied as a single coat and hardened in accordance with manufacturer's recommendations. The dry film thickness shall be 2.5 to 3.5 mils (64 to 89 micrometers) as measured by SSPC-PA 2 unless otherwise designated. It should be noted that coating thickness measurement by the technique described in SSPC-PA 2 compensates for variation in surface profile and results in the coating thickness being measured above the magnetic average of the peaks of the anchor pattern. Prior to any exposure testing, all panels shall be aged for 14 days at 60 to 80°F (16 to 27°C) and 35 to 65% relative humidity.

**6.2.2** The scribe mark shall be centrally positioned in the lower half of the panel and shall consist of an "x" comprising the diagonals of a 2 inch x 2 inch (50 mm x 50 mm) square. To insure proper positioning, cleanliness and depth of scribe mark, a template and scriber or cutting tool having a cutting edge at least 1/32 inch (0.8 mm) wide shall be used. The operator shall bear down hard and go over each arm of the cut at least twice to ensure a clean scribe of sufficient depth to remove any zinc particles from the scribe to expose clean steel.

**6.2.3** Prior to any exposure testing, all panels shall be aged for 14 days at 60 to 80°F (16 to 27°C) and 35 to 65% relative humidity.

**6.3 SALT FOG RESISTANCE:** The coating, when applied, hardened, aged and scribed in accordance with Section 6.2, shall pass 3,000 hours for inorganic primers and 1,000 hours for organic primers minimum exposure to salt fog (ASTM B 117) without any blistering or rusting of the coated portion, and with no undercutting from the scribe. Slight rusting in the scribe mark will be permissible and resulting staining should be ignored. Strips 1/4-inch (6 mm) wide along the edges of the panel may also be ignored. Testing shall be done in triplicate.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**PERFORMANCE REQUIREMENTS**

| | Number of Specimens | Exposure Time | Rust Rating SSPC-VIS 2 | Blister Rating ASTM D 714 | Scribe Undercutting ASTM D 1654 |
|---|---|---|---|---|---|
| SALT FOG RESISTANCE | | | | | |
| Type I (inorganic zinc primer) | 3 | 3000 hours | all 10 | all 10 | slight rust in scribe, no undercutting |
| Type II (organic zinc primer) | 3 | 1000 hours | all 10 | 6F min | slight rust in scribe, no undercutting |
| EXTERIOR EXPOSURE | | | | | |
| Type I (inorganic zinc primer) | | | | | |
| Level 1 | 3 | 12 months | 10, 10, 9* | all 10 | 1/32 inch (0.8 mm) maximum |
| Level 2 | 3 | 30 months | 9 min | all 10 | 1/16 inch (1.6 mm) maximum |
| Type II (organic zinc primer) | | | | | |
| Level 1 | 3 | 12 months | 9 min | all 10 | 1/16 inch (1.6 mm) maximum |
| Level 2 | 3 | 30 months | 8 min | all 10 | 1/8 inch (3.2 mm) maximum |
| ADHESION (ASTM D 3359) | | | | | |
| Types I & II | | | | | |
| (Levels 1 & 2) | | | | | |
| Unaged Primer | 3 | minimum rating of 4B | | | |
| Salt-Fog Aged Primer | 3 | minimum rating of 3B | | | |

* 2 of 3 panels must have ratings of 10, third panel can be a 9.

**6.4 ADHESION**

**6.4.1 Adhesion of Unaged Primer:** Triplicate panels shall be spray applied and hardened in accordance with Section 6.2.1 and 6.2.3. The adhesion shall be evaluated in accordance with the "cross-cut tape test," ASTM D 3359, Method B. The panel shall exhibit a rating of no less than 4B. There shall be no separation of the paint film or delamination of an entire square. Loss of adhesion around the perimeter due to cutting of these squares is acceptable.

**6.4.2 Adhesion of Accelerated Aged Primer:** Unscribed portions of the triplicate test panels exposed in the salt fog resistance test of Section 6.3 above shall be subjected to the "cross-cut tape test" (ASTM D 3359, Method B) within seven to 14 days after removal from the test chamber. Minimum rating shall be 3B.

**6.5 TEST FENCE EXPOSURE PERFORMANCE:**

**6.5.1 Test Exposures:** Triplicate panels prepared in accordance with Section 6.2 shall be exposed on a test fence at a severe marine exposure site. For the purposes of this specification, a severe marine site is defined as one located within 100 feet (30 meters) of the mean low tide level at a seacoast location (Note 11.3). Other criteria for classifying the environment such as corrosion rate of bare steel or bare zinc (in accordance with ASTM G 92) or mean annual precipitation and temperature may also be required when agreed among contracting parties (Note 11.3).

**6.5.2 Level 1 Qualification:** After a minimum of 12 months, the test specimens shall be examined for rusting (SSPC-VIS 2), blistering (ASTM D 714) and undercutting at the scribe (ASTM D 1654). (See Note 11.4.)

**6.5.2.1** Inorganic zinc primers (Type I) shall exhibit a 10 rust rating on two of the specimens and a minimum of 9 on the third specimen. No blistering shall be observed. Slight rusting is permitted in the scribe, but undercutting shall not exceed 1/32 inch (0.8 mm).

**6.5.2.2** Organic zinc primers (Type II) shall exhibit a minimum of 9 rust rating on all three specimens. No blistering shall be observed. Slight rusting is allowed in the scribe, but maximum undercutting shall not exceed 1/16 inch (1.6 mm).

**6.5.3. Level 2 Qualification:** The test specimen shall be examined after a minimum of 30 months for rusting,

Provided by : www.spic.ir Licensee: NISOC Library

blistering, and scribe undercutting.

**6.5.3.1** Inorganic zinc primers (Type I) shall have a minimum 9 rust rating on each of the three panels. No blistering shall be observed, and scribe undercutting shall not exceed 1/16 inch (1.6 mm).

**6.5.3.2** Organic zinc primers (Type II) shall exhibit a minimum of 8 rust rating on each of the three panels. Blistering shall be no greater than 6F, and scribe undercutting shall not exceed 1/8 inch (3.2 mm).

## 7. Material Quality Assurance

**7.1** In order to determine the acceptability of a batch of a qualified product, the paint shall meet the requirements of Sections 7.2 through 7.7. Samples of each batch shall be retained for two years from the date of manufacture.

**7.2** Viscosity of the mixed paint shall be determined in accordance with ASTM D 562, D 1200, or D 2196. Variance shall be within the limits agreed to by the paint manufacturer and purchaser.

**7.3** Density of the mixed paint shall be determined in accordance with ASTM D 1475. Variance shall be within ± 0.4 pounds/gallon (48 g/L) of the density of the previously qualified paint.

**7.4** Solids percent by weight of the mixed paint shall be determined in accordance with ASTM D 2369. Variance shall be within ± 2% of the percent solids by weight of the previously qualified paint.

**7.5** Density of the vehicle portion of a multicomponent coating, when supplied separately, shall be determined in accordance with ASTM D 1475. Variance shall be within ± 0.3 pounds/gallon (36 g/L) of the density of the previously qualified paint.

**7.6** Solids percent by weight of the vehicle portion of a multicomponent coating when supplied separately shall be determined in accordance with ASTM D 2369. Variance shall be within ± 2% of the percent solids by weight of the previously qualified paint.

**7.7** Other tests may be used to determine the acceptability of a lot or batch of a qualified product at the discretion of the user.

## 8. Labeling

**8.1** Refer to ANSI Z129.1. Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**8.2 MARKING OF CONTAINER:** Each container shall be legibly marked with the following information:

Name: Latex Painting System (Primer or Topcoat)
Specification: SSPC Painting System PS 24.00
Color:
Lot Number:
Stock Number:
Batch Number:
Quantity of Paint in Container:
Date of Manufacture:
Information and Warnings as may be required by Federal and State laws:
Manufacturer's Name and Address:

**8.3 PACKAGING:** Material shall be packaged and labeled in accordance with the requirements of ASTM D 3951 unless otherwise specified. The pigment portion of multicomponent zinc dust paints shall be packaged separately to be mixed with the liquid portion shortly before use and shall include directions showing correct mixing proportions and instructions. The packaging of single-component zinc paints shall also comply with the above documents.

**8.4 DIRECTIONS FOR USE:** The manufacturer shall supply complete instructions covering uses, surface preparation, mixing, thinning, application method, application conditions, pot life, wet and dry film thicknesses, temperature and humidity limitations, drying times, etc., with each container of paint.

## 9. Inspection

**9.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 11.9.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**9.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**9.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

Provided by : www.spic.ir Licensee: NISOC Library

## 10. Disclaimer

**10.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, paints or methods specified therein, or of the specification or standard itself.

**10.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 11. Notes

Notes are not a requirement of this specification.

**11.1** This primer covers a range of vehicle types (inorganic/organic, water-borne/solvent-borne, one-pack/two-pack/three-pack, chemical curing/thermoplastic). Consult SSPC-PS Guide 12.00, SSPC-PS 12.01 and coating manufacturers for specific exposure limitations.

**11.2** An alternative test method commonly specified is ASTM D 3960.

**11.3** The 25 meter (80 foot) lot at LaQue Center, Wrightsville (Kure Beach), NC, has been shown suitable for this specification's exterior marine exposure. The above test site has an average bare steel corrosion rate of about four to five mils (102 to 127 micrometers) per year, based on panels exposed for 12 months. Short term corrosion rates derived from panels exposed for one to three months can be as high as 20 to 30 mils (500 to 760 micrometers) per year.

**11.4** Level 1 qualification may be used as an interim qualification for a candidate zinc-rich primer. Under this scheme, a procuring agency could accept the primer for use on small structures, partial structure painting, or other limited applications. The interim qualification would be valid for a period of 18 months, at which time the longer test fence exposures (Level 2) would be completed.

**11.5 COVERAGE:** Except for special cases, most zinc primers are formulated to apply at nominal dry film thicknesses of 2.5 to 3.5 mils (64-89 micrometers). In actual practice, a coverage of 150 to 300 square feet per gallon (3.7 to 7.4 square meters per liter) will be expected over flat blast-cleaned surfaces.

**11.6 STORAGE:** Water-borne inorganic zinc paints should not be stored at temperatures below 40°F (4°C). Furthermore, storage of all zinc paints above 90°F (32°C) should be avoided.

**11.7 APPLICATION:** Water-borne zinc primers should not be applied at surface or air temperatures below 40°F (4°C) or when ambient conditions are expected to fall within these ranges during initial curing stages. Solvent borne inorganic zinc primers should not be applied at relative humidities below 50% without specific instructions from the manufacturer. Zinc dust primers should be applied within manufacturer's suggested guidelines regarding pot life and temperature constraints.

**11.8 OTHER STANDARDS:** Standard tests which may be useful for further qualification are available from a number of organizations, including ASTM, U.S. Government Federal and Military Specifications (TT-P; MIL-P; etc.), Federal Test Method Standards and Canadian Government Specifications Board. A partial listing of public zinc-rich specifications requiring qualification testing is presented in the Notes of SSPC-PS Guide 12.00. However, it should be emphasized that a well designed non-standard test may often provide more meaningful information for a given service condition than one or more standard tests.

**11.9** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

## 12. Supplementary Performance Tests

While not required to meet the requirements of this specification, the following or other performance tests may be valuable to the purchaser because of the diversity of possible service environments in which these primers may be used. Agreement between the contracting parties as to these tests and results must be established before issuing procurement documents.

**12.1 BULLET HOLE TEST:**

**12.1.1 Significance of Test:** This test is intended to evaluate the ability of a primer to sacrifice itself and cathodically protect adjacent areas of bare steel.

**12.1.2 Description of Test:** Test panels shall be triplicate flat mild steel plates, 3 inches x 6 inches x 1/16 inch (75 x 150 x 0.16 mm), blast cleaned to SSPC-SP 5. A magnet, tape or other suitable method is to be used to mask a 1.5 inch (3.8 cm) diameter circle in the center of the panel. Paint shall be applied according to the manufacturer's specifications, including recommended dry film thickness.

Provided by : www.spic.ir Licensee: NISOC Library

If masking tape is used, any residue remaining after the tape is removed must be cleaned from the panel with mineral spirits or other suitable methods which will not damage the test coating. The back of the panel is to be painted with vinyl (e.g., SSPC-Paint 9) or other resistant paint. Edges of the panel are to be dipped in the vinyl paint or protected from corrosion by another suitable method. Once the zinc dust primer is hardened for a minimum of two weeks, the panels are placed in a one-quart (0.95 L) jar, which is filled with a 5% sodium chloride solution. The water is changed weekly.

**12.1.3 Rating and Evaluation Criteria:** The time at which visible rust first appears anywhere on the panel is recorded. A coating will have passed the bullet hole test if none of the replicate panels exhibits visible rust within 21 days for an inorganic zinc primer or within 14 days for an organic zinc primer.

**12.1.4 Additional Notes:** Experimental results on bullet hole testing of various zinc-rich coatings are given in SSPC Report 87-02, "Level of Zinc Required in Zinc-Rich Paints." A similar bullet hole immersion test is described in AASHTO M 300, "Inorganic Zinc-Rich Primer."

**12.2 FUEL AND SALT WATER IMMERSION:**

**12.2.1 Significance of Test:** Inorganic zinc-rich coatings have been used in ballast tanks, which are alternately exposed to petroleum fuel and seawater ballast.

**12.2.2 Description of Test:** A test development by the U.S. Navy calls for immersion of two blast-cleaned panels in the following cycle: one week in 3% salt water; one week in aromatic synthetic gasoline; and two hours in hot (176°F, 80°C) synthetic sea water (to simulate cleaning conditions). Details are furnished in MIL-PRF-23236, "Paint Coating Systems, Steel Ship Tank, Fuel and Saltwater Ballast."

**12.2.3 Evaluation Criteria:** After 20 cycles, coatings are required to exhibit no pinpoint rusting, no loss of adhesion and no blisters larger than 1.5 millimeters (1/16 inch) in diameter, and no more than 3% of the surface covered with defects.

**12.3 ACCELERATED WEATHERING:**

**12.3.1 Significance of Test:** This test is primarily intended to determine the effect of ultraviolet radiation on degradation of the binder. Accordingly, it is most appropriate for organic-type binders or topcoated systems.

**12.3.2 Description of Test:** While three methods are described, the exact method shall be agreed to by the manufacturer and the purchaser. Suitable sized panels shall be prepared in accordance with Section 6.2 and tested in a carbon-arc light exposure apparatus (ASTM G 23, Method II with a 102 minute/18 minute light/water cycle, in a xenon arc light exposure apparatus, ASTM G 26), or in a fluorescent UV condensation type apparatus (ASTM G 53, four hour/four-hour UV/condensation cycle, using UV B bulb). Testing shall be done in triplicate for 1,000 to 2,000 hours. NOTE: ASTM Committee G3 suggest the use of UV-A bulbs in ASTM G-53.

**12.3.3 Evaluation Criteria:** The primer should be evaluated for a percent loss of gloss, fading, yellowing, chalking and other evidence of binder degradation at least once every 500 hours. All primers should be evaluated for rust formation, while organic primers should also be evaluated for UV degradation problems. Criteria for rejection should be mutually agreed upon between supplier and purchaser.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 30

## Weld-Through Inorganic Zinc Primer

### 1. Scope

**1.1** This specification covers a group of inorganic zinc primers which can protect steel during the fabrication process, permit welding to specification requirements, and be overcoated.

**1.2** The major pigment component in this coating is zinc dust, and the binder is inorganic.

**1.3** This specification defines the minimum compositional and laboratory performance requirements for characterizing a group of zinc primers. It is to be used in conjunction with SSPC-PS Guide 22.00, "Guide for Selecting One-Coat Preconstruction or Prefabrication Painting Systems," SSPC-PS Guide 12.00, "Guide for Selecting Zinc-Rich Painting Systems," and with other SSPC specifications covering surface preparation, applications, thickness, inspection, and safety.

### 2. Description

**2.1 GENERAL:**

**2.1.1** The zinc primers described in this specification consist of zinc dust, an inorganic vehicle, and selected additives, as required.

**2.1.2** This specification covers inorganic zinc primers which are used as preconstruction primers. Frequently the primer is applied by an automatic process to steel plate. Once applied, the zinc primer need not be removed. It can be welded through, touched-up, and overcoated prior to being placed in service.

**2.2 PIGMENTATION:**

**2.2.1** The major pigment component in these coatings is zinc dust of the type described in ASTM D 520.

**2.2.2** Other pigment components may include welding enhancers, curing aids, tinting colors, suspension, and pot life control agents.

**2.3 VEHICLE TYPES:**

**2.3.1** Water-reducible self-curing vehicles, including water soluble alkali metal silicates, quaternary ammonium silicates, phosphates, and modifications thereof. These coatings dry by evaporation of water and cure by chemical reaction to yield water-insoluble films.

**2.3.2** Solvent-reducible self-curing vehicles, including ethyl and other organic silicates, polymeric modifications of these silicates and titanates. These systems are dependent upon moisture in the atmosphere to complete hydrolysis to yield an insoluble film.

**2.3.3** Other organic vehicle components may be included but should constitute only a minor part of the total vehicle.

**2.4 VOLATILE ORGANIC COMPOUND (VOC) CONTENT:** The VOC content of the primer shall be determined from the content of coating as applied, after recommended thinning. (See Note 10.1.)

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PS Guide 12.00** | Guide to Zinc-Rich Coating Systems |
| **PS Guide 22.00** | Guide for Selecting One-Coat-Preconstruction or Prefabrication Painting Systems |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

Provided by : www.spic.ir Licensee: NISOC Library

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **A 36** | Specification for Carbon Structural Steel |
| **B 117** | Practice for Operating Salt Spray (Fog) Apparatus |
| **D 185** | Test Methods for Coarse Particles in Pigments, Pastes, and Paints |
| **D 520** | Specification for Zinc Dust Pigment |
| **D 521** | Test Methods for Chemical Analysis of Zinc Dust (Metallic Zinc Powder) |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 823** | Practices for Producing FIlms of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels |
| **D 1146** | Test Method for Blocking Point of Potentially Adhesive Layers |
| **D 1200** | Test Method for Viscosity by Ford Viscosity Cup |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1640** | Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature |
| **D 1654** | Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 2371** | Test Method for Pigment Content of Solvent-Reducible Paints |
| **D 3278** | Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus |
| **D 3359** | Test Methods for Measuring Adhesion by Tape Test |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |
| **D 3951** | Practice for Commercial Packaging |

**3.6 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals—Precautionary Labeling |

**3.7 AMERICAN WELDING SOCIETY (AWS) STANDARDS:**

| | |
|---|---|
| **B4.0** | Standard Methods for Mechanical Testing of Welds |
| **D1.1** | Structural Welding Code—Steel |

## 4. Composition

**4.1** The primer shall conform to the requirements of Sections 4.2 through 4.5.

**4.2** The vehicle shall be an inorganic self-curing silicate, or other material as described in Section 2.3.

**4.3 TOTAL SOLIDS:** The total solids shall be a minimum 55% by weight when measured in accordance with ASTM D 2369.

**4.4 ZINC DUST:** The zinc dust shall conform with ASTM D 520, Type I (See Note 10.2.)

**4.5 ZINC AS PERCENT OF SOLIDS:** Zinc dust shall constitute a minimum of 65% by weight of the total film solids. (See Note 10.3.)

## 5. Laboratory Test Requirements

**5.1** The primer shall meet the requirements of Sections 5.2. through 5.13.

**5.2 MIXING:** The components of the primer shall be mixed and dispersed as required to produce a product which is uniform, stable, free from grit, and conforms to the requirements of this specification. After mixing, the coarse particles and skins retained as residue on a standard 60 mesh screen shall be no more than 0.5% by weight of total paint, regardless of type, in accordance with ASTM D 185.

**5.3 POT LIFE:** The pot life of the zinc primer, when mixed and ready for application in accordance with the manufacturer's instructions, shall be a minimum of four hours at 70°F (21°C) and 50% relative humidity.

**5.4 STORAGE LIFE:** Neither the vehicle of the multi-component primer nor the single-component primer shall show thickening, curdling, gelling, gassing, or hard caking after being stored for nine months from date of manufacture in a tightly sealed, unopened container at a temperature of 50 to 90°F (10 to 32°C). (See Note 10.4.)

**5.5 WORKING PROPERTIES:** This material is primarily designed for automatic application by either conventional or airless spraying. The mixed paint shall spray easily to form a continuous film at approximately 0.75 mils (20 micrometers) dry film thickness (Note 10.5). The film should show no streaking, running, sagging, or other objectionable features when applied in accordance with ASTM D 823, Method D, and dried in a vertical position.

**5.6 TEST PANEL PREPARATION:** Steel test panels (ASTM A 36 hot rolled steel or equivalent) measuring 4 in

Provided by : www.spic.ir Licensee: NISOC Library

x 6 in x 1/8 in (100 mm x 150 mm x 3.2 mm) or greater, shall be near-white blast cleaned (SSPC-SP 10) with a surface profile from 1.0 to 2.0 mils (25 to 50 micrometers) and coated with the zinc primer. The surface profile should be measured in accordance with ASTM D 4417. The panels shall be blast cleaned and coated on both sides and all edges. The primer shall be spray applied and cured in accordance with the manufacturer's recommendations. The dry film thickness shall be 0.60 to 1.0 mils (15 to 25 micrometers) measured in accordance with SSPC-PA 2. Prior to any exposure testing, all panels shall be aged as recommended by the supplier.

**5.7 MUDCRACKING:** The primer, when applied in accordance with Section 5.6 to a 2.5 mil (65 micrometers) minimum dry film thickness, measured in accordance with SSPC-PA 2, shall show no mudcracking when viewed without magnification.

**5.8 ADHESION:** The primer, when applied and cured in accordance with Section 5.6, shall adhere to the steel substrate when subjected to ASTM D 3359, Method B, with a minimum rating of 3B. There shall be no separation of the film, or delamination of an entire square. Spalling (loss of adhesion around the perimeter due to cutting of each square inch) is acceptable.

**5.9 SALT FOG RESISTANCE:**

**5.9.1** The primer shall be applied and cured in accordance with Section 5.6 and scribed as follows: the scribe mark shall be centrally positioned in the lower half of the panel and shall consist of an "x" comprising the diagonals of a 2 in. x 2 in. (50 mm x 50 mm) square. To insure proper positioning, cleanliness, and depth of the scribe mark, a template and scriber conforming to ASTM D 1654 shall be used. The operator shall bear down hard and go over each arm of the cut at a 60 degree angle twice in the same direction to ensure a clean scribe of sufficient depth to remove any zinc particles from the scribe and to expose clean steel. Testing shall be done in triplicate.

**5.9.2** The scribed panels shall pass 750 hours minimum exposure to salt fog (ASTM B 117) without any blistering or rusting of the coated portion, with no undercutting of the scribe. (Slight rusting in the scribe mark will be permissible, and resulting staining should be ignored.) Strips 1/4 inch (6 mm) wide along the edges of the panel may be ignored.

**5.10 BLOCKING RESISTANCE:** When applied and cured as specified, test panels shall not stick when tested in accordance with ASTM D 1146.

**5.11 DRYING TIME:**

**5.11.1** When applied in accordance with Section 5.6 and cured at 75°F (24°C) and 50 to 60% relative humidity, the zinc primer shall dry-to-handle in 10 minutes, when tested in accordance with ASTM D 1640.

**5.11.2** When applied at ambient conditions and then dried at 300°F (149°C), the zinc primer shall dry-to-handle in two minutes.

**5.12 WELDABILITY:** Weldability requirements shall be determined by specific contract requirements. When applied at the specified thickness, and cured as recommended by the supplier, the prepared panels shall be subjected to a double fillet weld test. The primer shall not be removed in the path of the welds. Generally 3/8 inch thick x 6 inches wide x 2 feet long (9.5 mm thick x 150 mm wide x 0.6 mm long) steel plates may be used. Actual plate sizes and thicknesses shall be determined by the specific process to be qualified. Weld quality inspections and final acceptance of the welding procedure shall be in accordance with either the AWS Structural Welding Code D 1.1, or as defined in the contract specification.

**5.13** This primer, when applied over properly prepared steel surfaces, shall be compatible with the specified topcoat.

**5.14 ADDITIONAL RESISTANCE TESTS:** Because of the diversity of potential service environments, the user may require the zinc primer (after appropriate topcoating) be further exposed and qualified.

## 6. Material Quality Assurance

**6.1** In order to determine the acceptability of a lot or batch of a qualified product, the primer shall meet the requirements of Sections 6.2 through 6.4.

**6.2** Viscosity of the mixed primer shall be determined in accordance with ASTM D 562. Variance shall be within ±5 Krebs Units (or the equivalent units on other viscometers) of the viscosity of the previously qualified primer.

For viscosities lower than 55 KU, a #4 Ford Cup shall be used in accordance with ASTM D 1200. Variation shall be within ±5 seconds of the viscosity of the previously qualified primer.

**6.3** Density of the mixed primer shall be determined in accordance with ASTM D 1475. Variance shall be within ±2% of the nominal density of the previously qualified primer.

Provided by : www.spic.ir Licensee: NISOC Library

**6.4** Solids percent by weight of the mixed primer shall be determined in accordance with ASTM D 2369. Variance shall be within ±2% of the nominal percent solids by weight of the previously qualified primer.

**6.5** Other tests may be used to determine the acceptability of a lot or batch of a qualified product at the discretion of the user.

## 7. Labeling

**7.1** Refer to ANSI Z129.1. Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**7.2 MARKING OF CONTAINERS:** Each container she be legibly marked with the following information:

Name: Weld-Through Inorganic Zinc Primer
Specification: SSPC-Paint 30
Component:
Color:
Lot Number:
Batch Number:
Stock Number:
Date of Manufacture:
Expiration Date:
Quantity of Paint in Container:
Information and Warnings (as may be required by Federal and State Laws):
Manufacturer's Name and Address:

**7.3 PACKAGING:** Unless otherwise specified, materials shall be packaged and labeled in accordance with the requirements of ASTM D 3951, and as specified herein. The pigment portion of multi-component zinc primers shall be packaged separately, to be mixed with the liquid portion shortly before use. Directions showing correct proportions of liquid to pigment, along with the necessary mixing instructions, shall be included with the liquid component. One gallon and larger containers shall have wire bails, and five-gallon containers shall have wire bails with handles.

**7.4 DIRECTIONS FOR USE:** The manufacturer shall supply complete instructions covering uses, surface preparation, mixing, thinning, application method and conditions, pot life, dry film thickness, temperature and humidity limitations, and drying time with each container of primer. (See Note 10.6.)

## 8. Inspection

**8.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 10.8.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**8.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**8.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 9. Disclaimer

**9.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**9.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 10. Notes

Notes are not a requirement of this specification.

**10.1** This paint may not comply with some air pollution regulations because of its hydrocarbon solvent (VOC) content.

**10.2** Zinc dust may contain trace amounts of lead.

**10.3** Some zinc dust containing primers with less than 65% zinc by weight in the dry film, or other non-zinc containing primers, may pass the performance requirements of this specification. If agreed upon between purchaser and supplier, other composition requirements may be substituted for those in Section 4.

**10.4** Inorganic zinc primers should not be stored at temperatures below 40°F (4°C) or at temperatures above 90°F (32°C). Storage in direct sunlight should also be avoided.

Provided by : www.spic.ir Licensee: NISOC Library

**10.5** In actual practice, a coverage of 400 to 600 square feet per gallon (9 to 15 square meters per liter) will be expected over flat blast cleaned surfaces.

**10.6** Solvent-borne inorganic primers should not be applied at surface temperatures below 20°F (-7°C) or relative humidities below 50%. Water-borne inorganic zinc primers should not be applied below 50°F (10°C) or above substrate temperatures of 110°F (44°C). A minimum of 5°F (3°C) temperature range should be maintained between the dew point and substrate temperature. When the dew point is within 10°F (6°C) of the substrate temperature, adequate air movement across the surface should be maintained to insure the necessary evaporation rate for drying.

**10.7** The flash point, as determined by the Setaflash closed cup apparatus (ASTM D 3278), should be "none" for water-borne inorganic zinc primers, and a minimum of 50°F (10°C) for solvent-borne inorganic zincs.

**10.8** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 31
September 1, 1994
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 31

## Single-Package Waterborne Alkyd Primer for Steel Surfaces, Performance-Based

## 1. Scope

**1.1** This specification covers an air-drying, ready-mixed, pigmented, waterborne (i.e., water-reducible) alkyd or modified alkyd pigmented primer for blast cleaned steel. It is intended as the first coat of a waterborne coating system consisting of one or two coats of this primer and one or two coats of a waterborne topcoat.

**1.2** This primer is suitable for exposures in Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water [excluding immersion]) and 2B (frequently wet by salt water [excluding immersion]). See Note 11.1.

**1.3** This primer is intended for brush, spray, or roller application over steel surfaces prepared in accordance with SSPC-SP 6, "Commercial Blast Cleaning." It is suitable as a shop primer, field primer, maintenance primer, or intermediate coat, and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel." If the primed part of the structure is to be exposed to the weather, it should be topcoated as soon as practical, according to the manufacturer's published instructions.

**1.4** This specification does not include primers based on latex polymers, which are described in SSPC Painting System 24.00.

## 2. Description

**2.1 COMPOSITION**

**2.1.1** This primer is based on an ambient drying single-package vehicle which is rendered water-reducible via ionic solubility of the resin and appropriate pigments.

**2.1.2** The polymer types are alkyds and copolymer alkyds (see Note 11.2). Latex polymers are excluded from this specification.

**2.1.3** The major volatile component by weight shall be water; however, volatile organic compounds may be present.

**2.2 VOLATILE ORGANIC COMPOUND (VOC) CONTENT:**

**2.2.1** The VOC content of the primer shall be determined from the coating as applied, after recommended thinning. (See Section 4.2 and Note 11.4.)

**2.3 PERFORMANCE LEVELS:**

**2.3.1** Primers shall be classified according to the performance achieved as follows:

**Level 1:** Laboratory Testing (Section 5)
**Level 2:** Exterior Exposure (Section 6)

**2.3.2** If no performance level is specified, Level 2 is assumed.

## 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

**3.3** If there is a conflict between the requirements of any one of the cited reference standards and this specification, the requirements of this specification shall prevail.

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **Paint 25** | Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer |
| **PS 24.00** | Latex Painting System for Industrial and Marine Atmospheres, Performance-Based |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **VIS 2** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |

Provided by : www.spic.ir Licensee: NISOC Library

**3.5 AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **A 569** | Specification for Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality |
| **B 117** | Practice for Operating Salt Spray (Fog) Apparatus |
| **D 522** | Test Methods for Mandrel Bend Test of Attached Organic Coatings |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 609** | Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products |
| **D 610** | Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces |
| **D 714** | Test Method for Evaluating Degree of Blistering of Paints |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1212** | Test Methods for Measurement of Wet Film Thickness of Organic Coatings |
| **D 1308** | Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1640** | Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature |
| **D 1654** | Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments |
| **D 1849** | Test Method for Package Stability of Paint |
| **D 2243** | Test Method for Freeze-Thaw Resistance of Water-Borne Coatings |
| **D 2247** | Practice for Testing Water Resistance of Coatings in 100% Relative Humidity |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 2574** | Test Method for Resistance of Emulsion Paints in the Container to Attack by Microorganisms |
| **D 3359** | Test Methods for Measuring Adhesion by Tape Test |
| **D 3363** | Test Method for Film Hardness by Pencil Test |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |
| **D 3960** | Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings |
| **D 4400** | Test Method for Sag Resistance of Paints Using a Multinotch Applicator |
| **D 4417** | Test Methods for Field Measurement of Surface Profile of Blast-Cleaned Steel |
| **G 92** | Practice for Characteristization of Atmospheric Test Sites |

**3.6 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals—Precautionary Labeling |

**3.7 FEDERAL STANDARD:**

**40 CFR 60, Appendix A, Method 24**—Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings

## 4. Composition

**4.1** The manufacturer is given latitude in the selection of materials and process of manufacture, provided that the primer meets the requirements of this specification. Materials shall be those used in good commercial practice and entirely suitable for the purpose intended under normal conditions of use.

**4.2** The VOC content shall be measured by EPA Method 24, ASTM D 3960, or other approved methods. If no method is specified, use EPA Method 24. Supplier should provide information on the VOC content of the coating as supplied (in the container) and as applied (in the field after recommended thinning).

**4.3** Pigments and other primer components shall contain a maximum of 0.06% by weight of lead or chromate in the dry film.

## 5. Laboratory Testing

**5.1** For Level 1, the paint shall meet the requirements of Table 1 and Sections 5.2 through 5.12.

**5.2 RESISTANCE TO MICROORGANISM ATTACK IN THE CONTAINER:** The paint shall be resistant to attack by microorganisms when tested according to ASTM D 2574.

**5.3 LABORATORY APPLICATION PROPERTIES:** The primer shall be readily applied to a smooth steel vertical surface by brush, spray, or roller. A minimum of 4 mils (100 micrometers) wet film thickness shall be applied as measured by ASTM D 1212. Drying shall be done in a ventilated room or chamber free from drafts and dust and in diffused light, not in direct sunlight. The temperature of the air shall be between 70 and 77°F (21 and 25°C) and the relative humidity 50% ± 5%. There shall be no runs, sags, streaks,

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**PROPERTIES**

| | REQUIREMENTS | | |
|---|---|---|---|
| | Min. | Max. | ASTM |
| Viscosity shear rate, 200 rpm | | | |
| Grams | 165 | 700 | D 562 |
| Krebs Units | 75 | 125 | D 562 |
| Fineness of grind, Hegman units | 4.0 | — | D 1210 |
| Drying time, hours (See Note 11.9) | | | |
| Dry to touch | — | 8 | D 1640 |
| Dry hard | — | 24 | D 1640 |
| Sag Resistance, wet mils (micrometers) determined at 50 ± 5% relative humidity | 6 (150) | — | D 4400 |

laps, pinholing, fisheyeing, or cratering. The dry film thickness of one coat as measured by SSPC-PA 2 shall not be less than 1.5 mils (38 micrometers). The primer shall be recoated at 24 and 48 hours according to the manufacturer's recommendations. There shall be no picking-up, rolling-up, or lifting of the primer during recoat at 24 and 48 hours. Twenty-four hours after recoating, the film shall be smooth and uniform.

**5.4 CONDITION IN CONTAINER:** The primer as received shall show no evidence of skinning, or hard settling of the pigment. The inside of the container shall not be corroded. Any settled material shall be easily dispersed in the liquid portion by hand stirring to form a smooth, homogeneous consistency. The primer shall show a minimum of foaming and be free of grit, seeds, or lumps.

**5.5 FREEZE/THAW RESISTANCE:** The primer shall pass three cycles when tested according to the procedure described in ASTM D 2243. After cycling, there shall be no gelation or excessive thickening, coagulation, lumps, or coarse particles. The maximum allowable increase or decrease in viscosity shall not exceed 15 Krebs units. After being subjected to the above test, the primer shall also pass the tests outlined in Sections 5.3 and 5.4.

**5.6 PACKAGE STABILITY:** Perform the following tests in accordance with ASTM D 1849. When stored for one month at 124 to 127°F (51 to 53°C), the maximum allowable increase or decrease in viscosity shall not exceed 10 Krebs units. After brushing out, the film shall be free from grains, lumps, or streaks. After being subjected to the above test, the primer shall also pass the tests outlined in Sections 5.3 and 5.4.

**5.7 MECHANICAL STABILITY:** Fill a one-quart (one-liter) friction top can three-quarters full with the primer and close the can tightly. Rotate on a jar roller for 168 hours (one week) at 120 to 170 rpm. At the end of 168 hours, there shall be no indication of separation, coagulation, excessive foaming, excessive thickening, or loss in mechanical stability. The maximum allowable increase or decrease in viscosity shall not exceed 15 Krebs units. After being subjected to the above test, the primer shall also pass the tests outlined in Sections 5.3 and 5.4.

**5.8 WATER INSENSITIVITY:** Apply one coat of the waterborne primer by the drawdown method to a 4 x 8 inch (100 mm x 200 mm) cold-rolled steel panel (ASTM D 609, Type 2) to produce a dry film thickness of 2.0 ± 0.5 mils (50 ± 13 micrometers). Allow to dry at 70 to 77°F (21 to 25 °C) and 50% ± 5% relative humidity. After 24 hours drying time, subject the coating to a water spot test for four hours in accordance with ASTM D 1308. No blistering shall occur. The film may soften, but film integrity shall return after a 24 hour recovery period. Film integrity is defined as losing no more than one pencil hardness unit (ASTM D 3363) compared to the unexposed film. (See Note 11.5.)

**5.9 SALT SPRAY AND HUMIDITY TESTING**

**5.9.1** Prepare six 4 x 8 x 1/8 inch (100 x 200 x 3.2 mm) ASTM A 569 hot rolled steel panels abrasive blasted in accordance with SSPC-SP 5 with a profile of 2.0 ± 0.5 mils (50 ± 13 micrometers) measured in accordance with ASTM D 4417. Apply one coat of primer to produce a dry film thickness of 2.0 ± 0.5 mils (50 ± 13 micrometers) on all eight panels. Four panels shall dry 48 hours before a second coat of primer is applied so as to obtain a total thickness of 3.5 ± 0.5 mils dry (90 ± 13 micrometers). These panels and the single prime coat panels shall be allowed to dry for an additional 14 days. Coat and seal all edges and the back side with a suitable protective coating.

**5.9.2** Scribe two single prime and two double prime panels to produce a 5 inch (13 mm) vertical cut exposing the underlying metal. Conditions of making the scribe shall be as described in ASTM D 1654.

Provided by : www.spic.ir Licensee: NISOC Library

**5.9.3** Expose the four scribed panels (two single prime and two double prime) in the salt fog cabinet operated according to ASTM B 117. After the specified number of hours, the panels shall be removed, dried, and rated for blistering according to ASTM D 714. After rating for blistering, immediately remove the paint film with the aid of a spatula or razor blade. Examine the steel substrate for corrosion and rust creepage according to ASTM D 1654. The condition may be preserved by applying a clear varnish.

The ratings of the panels shall be:

- one coat primer exposed 240 hours will give corrosion of 8 or better, scribe 7 or better and a blister rating 2F or better.

- two coat primer exposed 500 hours will give corrosion of 8 or better, scribe of 7 or better, and a blister rating of 2F or better.

**5.9.4** The remaining two double prime panels shall be exposed on the Cleveland Condensing Humidity Cabinet operated according to ASTM D 2247 and should be rated by ASTM D 714 and ASTM D 1654 Method B.

- double prime exposed 96 hours will give corrosion of 8 or better and blistering of 2F or better.

**5.10 ADHESION:** The coating, when applied and dried in accordance with the conditions in Section 5.11, and subjected to the "Cross-Cut Tape Test" (ASTM D 3359, Method B) shall have an adhesion rating no less than "4B" grading.

**5.11 EARLY RUST RESISTANCE TEST**

**5.11.1.** Prepare two 4 x 8 x 1/8 inch (100 x 200 x 3.2 mm) hot rolled steel panels by blast cleaning to white metal according to SSPC-SP 5. Allow brush, paint, and panels to equilibrate in a controlled environment chamber maintained at 48 to 52°F (9 to 11°C) and 75 to 80% relative humidity for at least 30 minutes. Apply the paint by brushing to a dry film thickness of 1.5 ± 0.5 mils (38 ± 13 micrometers) and allow to cure for 16 hours in the controlled environment.

**5.11.2** Remove the panels from the chamber and support them facing up about 1/2 inch (13 mm) above a water trough containing 1 inch (25 mm) of cold (48 to 52°F [9 to 11°C]) water. Place a piece of cheesecloth over the panels and sprinkle cold (48 to 52 °F [9 to 11°C]) water on it. Make sure the cheesecloth is always totally wet during the complete test period. At the end of 24 hours no sign of early rusting shall be allowed.

**5.12 FLEXIBILITY:** Flexibility shall be determined in accordance with ASTM D 522 Method B. Apply a 2 inch (50 mm) wide film of the paint with a film applicator that will give a dry film thickness of 2.0 ± 0.5 mil (50 ± 13 micrometers) on a smooth finish steel panel, prepared in accordance with ASTM D 609, paragraph 5.3 Method C, using the aliphatic naphtha propylene glycol monomethyl ether mixture. The panel shall be new, cold rolled, rust-free carbon steel No. 22 gage as defined by Type No. 1 in Table 1 of ASTM D 609. The coated panel shall air dry for 24 hours at a temperature of 70 to 77°F (21 to 25°C) and then shall be put in an oven at 98 to 102°F (37 to 39°C) for four days. Condition the panel at 70 to 75 °F (21 to 25°C) for two hours. Bend panel over a 1/4 inch (6.4 mm) mandrel. Examine the bend for paint cracking visible to the unaided eye. There shall be no visible cracking.

## 6. Test Fence Performance Requirements

**6.1** For Level 2, the paint shall meet the requirements 6.2, 6.3, and those of Level 1.

**6.2** Three "double prime" panels shall be prepared as described in 5.9.1. The dry film thickness shall be 3.5 ± 0.5 mils (90 ± 13 micrometers). A set of solvent alkyd control panels using SSPC-Paint 25 must be exposed concurrently. The panels shall be scribed as described in Section 5.9.2.

**6.3 EXTERIOR EXPOSURE:** Triplicate test panels shall be exposed for a minimum of 18 months at a test fence at an industrial or marine exposure site with a minimum annual mean precipitation of 25 inches (625 mm) per year. Other criteria for classifying the environment such as corrosion rate of bare steel or bare zinc (in accordance with ASTM G 92), or minimum mean annual temperature, may also be required when agreed to between contracting parties. (See Note 11.6.) Each specimen shall meet the following requirements:

- Minimum rust rating of 8 in accordance with SSPC-VIS 2/ASTM D 610
- Maximum scribe undercutting of 1/16 inch (0.8 mm)

## 7. Material Quality Assurance

**7.1** The manufacturer should measure and record batch testing information that would allow certification that a batch of paint meets the necessary standards established by the manufacturer for the primer as tested per Sections 5 and 6.

**7.2 COLOR:** The color shall be as specified in the procurement documents.

Provided by : www.spic.ir Licensee: NISOC Library

**7.4 VISCOSITY:** The viscosity of the mixed primer shall be determined in accordance with ASTM D 562. Variance shall be within ± 5 Krebs Units, or equivalent units of another viscometer, of the viscosity of the previously qualified primer.

**7.5 DENSITY:** Density of the mixed primer shall be determined in accordance with ASTM D 1475. Variance shall be within ±0.4 pounds per gallon (50 g/L) of the nominal density of the previously qualified primer.

**7.6 SOLIDS BY WEIGHT:** Solids by weight of the mixed primer shall be determined in accordance with ASTM D 2369. Variance shall be within ±2% of the nominal percent solids by weight of the previously qualified primer (see Note 11.7).

## 8. Labeling

**8.1** Refer to ANSI Standard Z129.1. Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**8.2 MARKING OF CONTAINERS:** Each container shall be legibly marked with the following information:

Name: Single Package Waterborne Alkyd Primer for Steel Surfaces, Performance-Based
Specification: SSPC-Paint 31
Color:
Lot No.:
Stock No.:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
VOC Content (see section 4.2):
Manufacturer's Name and Address:
Keep from Freezing

**8.3: DIRECTIONS FOR USE:** The directions for use should be supplied by the manufacturer with each container of paint. If no directions are furnished, the directions in Note 11.8 should be used.

## 9. Inspection

**9.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 11.3.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**9.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**9.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 10. Disclaimer

**10.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**10.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 11. Notes

**11.1 Environmental Zone Descriptions**

1A Interior, normally dry (or temporary protection). Very mild (oil base paints now last six years or more).
1B Exteriors, normally dry (includes most areas where oil base paints now last six years or more)
2A Frequently wet by fresh water. Involves condensation, splash, spray, or frequent immersion (oil base paints now last five years or less).
2B Frequently wet by salt water. Involves condensation, splash, spray, or frequent immersion (oil base paints now last three years or less).

**11.2** Primers based on water-reducible epoxy esters may also meet the performance requirements of this specification.

**11.3** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**11.4** The primer may not comply with all air pollution regulations. Consult applicable government regulations to

Provided by : www.spic.ir Licensee: NISOC Library

determine maximum allowable VOC and proper VOC determination test method for a particular application.

**11.5** Pencil hardness units are as follows: 6B (softest), 5B, 4B, 3B, 2B, B, HB, F, H, 2H, 3H, 4H, 5H, 6H (hardest).

**11.6** The 250 meter lot (800 ft lot) at the LaQue Center, Wrightsville (Kure) Beach, NC and the Neville Island and coke works sites in Pittsburgh, with average bare steel corrosion rates of one to three mils (25 to 76 micrometers) per year based on panels exposed for 12 months, have been shown suitable for this specification's exterior exposure. The test coatings used to establish the performance requirement were evaluated at these test sites.

**11.7** The supplier should also furnish information on the volume solids and the theoretical spreading rate (square feet per gallon for one mil of dry paint) [square meters per liter for one micrometer of dry paint].

**11.8 DIRECTIONS FOR USE OF SINGLE-PACKAGE WATERBORNE ALKYD PRIMER FOR STEEL SURFACES, PERFORMANCE-BASED:**

**11.8.1** This paint is intended for use as a primer over blast cleaned steel in atmospheric exposure. It is intended as the first coat of a waterborne coating system consisting of two coats of this primer and one or two coats of a waterborne topcoat. It may also be used over previously coated surfaces after compatibility has been established.

**11.8.2** Mix paint thoroughly before use. If the pigment has settled, pour off most of the liquid. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring contents to a larger container or by pouring the paint to and from another container. Examine the bottom of containers for unmixed pigment. Screen paint before applying.

**11.8.3** Thin paint only if necessary, using only deionized or potable water. For brush application under normal conditions, no thinning should be necessary. For spray applications add up to one-half pint of water per gallon of paint (62 cc per liter) when necessary.

**11.8.4** This paint may be applied by spray, brush, or roll. Cross-brushing or cross spraying application is highly desirable. Application by spray tends to provide the best leveling. Apply to the specified film thickness, or, if none is specified, to at least 1.5 mils (38 micrometers) dry or approximately 6 mils (150 micrometers) wet. If the primed part of the structure is to be exposed to the weather, it should be topcoated as soon as practical.

**11.8.5** The atmospheric conditions at the time this coating is applied are extremely important. This primer shall not be applied at a temperature below 40°F (4°C) or above 120°F (49°C). The manufacturer's recommendations on humidity and dew point shall be followed.

**11.8.6** The best conditions for storage of this coating are at temperatures between 40°F (4°C) and 75°F (24°C). This coating shall never be allowed to attain temperatures over 120°F (49°C) or subjected to repeated freezing and thawing. When stored at temperatures of 120°F and above (49°C and above), shelf life is decreased markedly.

**11.8.7** Allow paint at least 24 hours drying time in good weather before recoating.

**11.9** Consult coating manufacturer regarding "dry to handle" times for shop-applied coatings.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 32
June 1, 1994
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 32

## Coal Tar Emulsion Coating

### 1. Scope

**1.1** This specification covers a coal tar emulsion coating to be used as a protective weather coat for hot or cold applied bituminous coatings on steel structures. It may also be used over suitable primers as a protective coating for above-ground steel structures subjected to atmospheric exposure in industrial areas.

**1.2** This coating is suitable for use as a topcoat over hot or cold applied coal tar base coatings to provide protection against the deleterious effects of oxidation and ultraviolet radiation in Environmental Zone 1B (exterior, normally dry). It can also be used in heavy industrial environments such as Zones 3A (chemical exposure acidic), 3B (chemical exposure neutral) and 3C (chemical exposure alkaline) where color is not a prime consideration.

### 2. Description

**2.1** This coating is a water emulsion of coal tar and contains selected fillers. It is a thick, heavy-duty, cold-applied protective coating intended for use on steel substrates coated with hot or cold-applied bituminous coatings or other suitable primers.

**2.2** This coating contains approximately 40% by volume non-volatile film forming solids. The theoretical spreading rate for a 15 mil (380 micrometers) dry film thickness is 42 square feet/ gallon (1.0 square meter/liter). Actual spreading rates can be significantly lower. (See Note 9.1.)

**2.3 VOLATILE ORGANIC COMPOUND (VOC) CONTENT:** Unless otherwise specified in procurement documents, the VOC content shall be determined using EPA Method 24. (See Note 9.2.)

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7, and form a part of this specification.

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

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

**3.4 SSPC STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness with Magnetic Gages |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 95** | Test Method for Water in Petroleum Products and Bituminous Materials by Distillation |
| **D 529** | Test Method for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Carbon-Arc Method) |
| **D 2939** | Test Methods for Testing Emulsified Bitumens Used as Protective Coatings |
| **D 3924** | Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials |
| **G 23** | (canceled) Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials [Replaced with Appropriate cycle of G 151 to G 155.] |

**3.6 FEDERAL STANDARDS:**

**MIL-PRF-2104** Lubricating Oil, Internal Combustion Engine, Combat/Tactical Service

**40 CFR 60, Appendix A, Method 24**—Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals—Precautionary Labeling |

### 4. Composition

**4.1 MATERIAL:** The coating shall be an emulsified coke-oven coal tar of such consistency as to be readily applicable either by brush or spray. The coating may be formulated to contain mineral filler. The coal tar used in this coating is defined as a product obtained from the distillation

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**REQUIREMENTS**

| PROPERTY | CHARACTERISTICS Min. | Max. | TEST METHOD |
|---|---|---|---|
| Residue by evaporation, wt % | 45 | — | ASTM D 2939 |
| Ash content of residue, wt % | 25 | 40 | ASTM D 2939 |
| Water content, wt % | — | 50 | ASTM D 95, 16 to18 gram sample, industrial grade xylene as solvent |
| Sag | No appreciable sag or flow while wet | | Section 5.3 |
| Water absorption, wt % | — and no softening or signs of separation | 10 | Section 5.4 |
| Resistance to oil | No softening or evidence of solubility | | Section 5.5 |
| Resistance to alligatoring | No disbonding, cracking, crazing, or alligatoring | | Section 5.6 |

of high-temperature crude coke oven tar, which in itself is a product obtained during the destructive distillation of coal in slot ovens operated at a temperature above 1,292°F (700°C). The coal tar shall be composed primarily of a complex combination of condensed ring aromatic hydrocarbons of three or more members. The coating shall not contain asphalt or asbestos.

## 5. Properties

Unless otherwise specified herein, or in referenced test methods, properties will be tested at standard atmospheric conditions as specified in ASTM D 3924.

**5.1 GENERAL PERFORMANCE REQUIREMENTS:** The coating shall conform to the following:

a. Shall be homogeneous, other than moderate water separation, without packing hard in the container. Any water that separates shall be readily incorporated upon stirring.

b. Shall be readily applicable to dried bituminous protective coatings.

c. When applied to vertical surfaces at specified thickness, shall not sag, and upon drying, shall not flow at any temperature.

d. Shall not have a pronounced or unduly objectionable odor.

e. When applied to dried bituminous protective coatings, shall not soften, disbond, or delaminate upon being intermittently immersed in sea water or fresh water.

**5.2 PHYSICAL REQUIREMENTS:** The coating shall conform to the requirements given in Table 1.

**5.3 SAG:** Apply the coating to a 12 x 12 x 1/8 inch (300 x 300 x 3 mm) clean, sand blasted (SSPC-SP 5) mild steel plate, to a uniform wet film thickness of 30 ± 2 mils (760 ± 50 micrometers). Immediately suspend the plate vertically at test conditions for 24 hours. Then examine the coating for sag or flow while wet.

**5.4 WATER ABSORPTION:** To three tarred aluminum panels, each 6 x 6 x 1/32 inch (150 x 150 x 0.8 mm), apply one coat of the coating to a uniform wet film thickness of 30 ± 2 mils (760 ± 50 micrometers). After the coating has dried for 96 hours, immerse the coated panels in distilled water for 15 days, and determine the water absorption. The water absorption is the percentage gain in water based on the difference in the initial weight of the coating after 96 hours drying time (determined after dipping the panel momentarily in distilled water and wiping lightly with a paper towel) and the final weight of the coating after 15 days immersion.

**5.5 RESISTANCE TO OIL:** Apply the coating to two wire brushed, coal tar naphtha solvent cleaned mild steel panels, each 6 x 6 x 1/8 inch (150 x 150 x 3 mm) to a uniform wet film thickness of 30 ± 2 mils (760 ± 50 micrometers). After the coating has dried for 96 hours, immerse the coated panels in MIL-PRF-2104, grade 30 lubricating oil, for 24 hours. Examine the coating for softening, loss of adhesion, or any other deterioration.

**5.6 RESISTANCE TO ALLIGATORING:** To three aluminum panels, each approximately 3 x 6 x 1/32 inch (75 x 150 x 1.8 mm) [size may vary as required by accelerated weathering unit], apply two coats of the coating to produce a uniform dry film thickness of 30 ± 2 mils (760 ± 50 micrometers). Apply two coats at right angles to each other,

Provided by : www.spic.ir Licensee: NISOC Library

with a drying period of 24 hours between coats. After the second coat has dried for 96 hours, subject the coated panels to 15 days of accelerated weathering in accordance with ASTM D 529, Daily Cycle A, except that the apparatus may be either Type A or Type D of ASTM G 23. At the end of the fifteenth cycle, examine visually for disbonding, cracking, crazing, or alligatoring.

## 6. Labeling

**6.1** Refer to ANSI Standard Z129.1. Other guidelines can be found in the National Paint and Coatings Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legibly marked with the following information:

Name: Coal Tar Emulsion Coating
Specification: SSPC-Paint 32
Color: Black
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Coating in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions use shall be supplied with each container of coating:

Directions for Use of Coal Tar Emulsion Coating

This emulsion coating is primarily designed to be used as a topcoat over hot or cold applied bituminous coatings. It may also be used as a protective coating over other suitable primers for atmospheric protection of metal substrates in heavy industrial atmospheres.

Mix coating thoroughly before use. Under normal conditions, no thinning should be necessary. Thin only when necessary, using only clean potable water.

If applied by brush, a proper technique must be developed to ensure application of correct thickness. If coating large areas, spray application is recommended using either high pressure airless or conventional spray equipment designed for the application of mastics.

Apply to the specified film thickness, or, if none is specified, approximately 15 mils (380 micrometers) dry or approximately 38 mils (965 micrometers) wet. The surface to be coated shall be dry; the surface temperature shall be at least 5°F (3°C) above the dew point, and the temperature of the surface shall be over 40°F (4°C). Do not apply outdoors in rainy weather or if freezing temperatures are expected before the coating dries. Under normal conditions this coating will be dry for recoating in two to six hours. High relative humidities may require 24 to 48 hours between coats. After the surface drying, the coating will remain soft for long periods.

Protect from freezing.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.3.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not a requirement of this specification.

**9.1** The supplier should also furnish information on the volume solids and theoretical spreading rate (square feet per gallon for one mil of dry paint [square meters per liter for one micrometer of dry paint]).

Provided by : www.spic.ir Licensee: NISOC Library

**9.2** VOC information may be supplied on the label or the technical data sheet.

**9.3** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 33
June 1, 1994
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 33

## Coal Tar Mastic, Cold Applied

### 1. Scope

**1.1** This specification covers a cold applied coal tar coating for use on underground and underwater steel structures.

**1.2 INTENDED USE:** This coating is suitable for use on structures exposed in Environmental Zones 2A (frequently wet by fresh water), 2B (frequently wet by salt water), 2C (fresh water immersion), 2D (salt water immersion), 3B (chemical exposure neutral), and 3C (chemical exposure alkaline). The coating is also suitable for use on hydraulic structures and pipe. It must be used with discretion for immersion in corrosive chemicals since the coating is dissolved by some organic solvents and attacked by oxidizing solutions.

**1.3** To prevent checking and alligatoring when exposed to sunlight, the coating must be topcoated with coal tar emulsion meeting SSPC-Paint 32.

### 2. Description

**2.1** This coating is a cold applied, black, self-priming, heavy-duty protective coating. It is based on a blend of coal tar pitch, selected solvents, and fillers.

**2.2** The coating contains approximately 70% by volume of non-volatile film forming solids. The theoretical spreading rate for a 15 mil (380 micrometers) dry film thickness is approximately 75 square feet/gallon (1.8 square meters/liter). Actual spreading rates can be significantly lower. (See Note 9.1.)

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7, and form a part of this specification.

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

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

**3.4 SSPC STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 95** | Test Method for Water in Petroleum Products and Bituminous Materials by Distillation |
| **D 529** | Test Method for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Carbon-Arc Method) |
| **D 2939** | Test Methods for Testing Emulsified Bitumens Used as Protective Coatings |
| **D 3924** | Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials |
| **G 23** | (canceled) Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials [Replaced with appropriate cycle of G 151 to G 155.] |

**3.6 FEDERAL STANDARDS:**

| | |
|---|---|
| **MIL-PRF-2104** | Lubricating Oil, Internal Combustion Engine, Combat/Tactical Service |

**40 CFR 60, Appendix A, Method 24**—Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals—Precautionary Labeling |

### 4. Composition

**4.1 MATERIAL:** The coating shall be a homogeneous mixture composed only of coal tar pitch, solvents, and inert

Provided by : www.spic.ir Licensee: NISOC Library

non-water-absorbent mineral filler. The coal tar pitch used in this coating is defined as a product obtained from the distillation of high temperature crude coke oven tar, which in itself is a product obtained during the destructive distillation of coal in slot ovens operated at a temperature above 1,292°F (700°C). The coal tar pitch shall be composed primarily of a complex combination of condensed ring aromatic hydrocarbons of three or more members. The coating shall not contain asphalt or asbestos.

**4.2 SOLVENT CONTENT AND COMPOSITION:** When required, the coating shall conform to applicable air quality control regulations as specified. Consult applicable government regulations to determine maximum allowable VOC content. Supplier should provide VOC information on the coating as supplied (in the container) and as applied (in the field after recommended thinning). Unless otherwise specified in procurement documents, use EPA Method 24 to determine VOC content. (See Note 9.2.)

## 5. Properties

**5.1 REQUIREMENTS:** The coating shall conform to the requirements given in Table 1. Unless otherwise specified herein or in referenced test methods, properties will be tested at standard atmospheric conditions as specified in ASTM D 3924.

**5.2 WORKABILITY:** Test the coating applied cold, for firm adherence to bare steel, compatible primer (if used), and itself. The coating shall permit easy application by brush or spray, in two successive coats, to a minimum dry film thickness of 30 ± 2 mils (760 ± 50 micrometers). At 45 ± 4°F (7 ± 2°C), the coating shall permit easy brush application.

**5.3 SAG:** Apply the coating to a clean, smooth 12 x 12 x 1/8 inch (300 x 300 x 3 mm) steel plate, to a uniform wet film thickness of 30 ± 2 mils (760 ± 50 micrometers). Immediately after application, suspend the panel in a vertical position at application conditions for 24 hours. Then examine for evidence of sag or flow while wet. Prepare a second panel as described, except to a uniform wet film thickness of 15 ± 1 mils (380 ± 25 micrometers). Immediately after application, suspend the panel in a vertical position at 160 ± 5°F (71 ± 2°C) for 1 hour. Then examine for conformance to Table 1.

**5.4 ADHESION AND PROTECTION:** Expose the coated panel (see 5.3) to 140 ± 5°F (60 ± 2°C) for 16 hours. Allow the panel to cool at room temperature for one hour, then expose to -10 ± 4°F (-23 ± 2°C) for four hours. Examine the coating for conformance to Table 1.

**5.5 RESISTANCE TO IMPACT:** Apply the coating to two wire brushed, solvent cleaned (xylene), mild steel plates, each 6 x 6 x 1/8 inch (150 x 150 x 3 mm) thick, to a uniform dry film thickness of 30 ± 2 mils (760 ± 50 micrometers). Dry 72 hours, then test each panel separately, while being held firmly, coated side up, on a solid horizontal base. Drop a 2 lb (0.9 kg) steel ball from a height of 8 feet (2.4 m) so that the impact will be at the center of the plate. Examine the coating for conformance to Table 1.

**5.6 RESISTANCE TO ALKALI:** Apply the coating to a clean glass panel at a uniform dry film thickness of 30 ± 2 mils (760 ± 50 micrometers). Dry the panel for 24 hours, then suspend vertically in 5% sodium hydroxide so that one-half of the coating is immersed. After 30 hours, lightly rub the film with a wet rounded glass rod and examine for conformance with Table 1.

## 6. Labeling

**6.1** Refer to ANSI Standard Z129.1. Other guidelines can be found in the National Paint and Coating (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS**

Each container shall be legibly marked with the following information:

Name: Coal Tar Mastic, Cold-Applied
Specification: SSPC-Paint 33
VOC Content:
Color: Black
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Coating in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of coating:

Directions for Use of Coal Tar Mastic, Cold Applied

This coating is used to provide corrosion protection to steel structures used in underground and underwater services. It will perform best if applied over blast-cleaned steel. When applied to surfaces which are prepared according to SSPC-SP 1, SSPC-SP 2, or SSPC-SP 3, performance longevity is shortened.

Mix coating thoroughly before use. Under normal conditions, no thinning should be necessary. Thin coating only if necessary, using only solvent recommended by manufacturer.

If applied by brush, technique must be developed to ensure application of proper thickness. If coating large

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**REQUIREMENTS**

| CHARACTERISTICS | | | |
|---|---|---|---|
| **PROPERTY** | **Min.** | **Max.** | **TEST METHOD** |
| Flash point, °C | 35 | — | ASTM D 92 |
| Distillation to 235°C, wt % | 15 | 30 | ASTM D 20 |
| Penetration of distillation residue, mm | 5 | 25 | ASTM D 5, residue sample sample of distillation to 235°C |
| Softening point of residue, °C | 96 | 115.5 | ASTM D 26, residue distillation sample of distillation to 235°C |
| Ash content of coating, wt % | 15 | 30 | ASTM D 128, rapid routine method |
| Tar acids of coating, mL/100g | — | 0.6 | ASTM D 453, distillation to 300°C |
| Workability | Satisfactory working and spreading | | See paragraph 5.2 |
| Sag | No sag or flow while wet | | See paragraph 5.3 |
| Drying | | | ASTM D 1630, doctor-blade application at 22 ± 2 mils (540 ± 50 micrometers) wet film thickness |
| 6 hours | Set to touch | | |
| 24 hours | Dry to recoat | | |
| Adhesion and protection | Shall not loosen, check, crack, peel, run, sag, or otherwise lose portection value | | See paragraph 5.4 |
| Resistance to impact | No visible chipping, cracking, or detachment from plate, and firm adhesion outside radius of 1/4 inch (6.4 mm) from center of impact | | See paragraph 5.5 |
| Resistance to alkali | No evidence of degradation | | See paragraph 5.6 |

areas, spray application is recommended, using either high pressure airless or conventional spray equipment designed for the application of mastics.

Apply to the specified film thickness, or, if none is specified, to a minimum of 15 mils (380 micrometers) dry or approximately 22 mils (540 micrometers) wet. The surface to be coated shall be dry; the surface temperature shall be at least 5°F (3°C) above the dew point; and the temperature of the air shall be over 40°F (4°C). Do not use outdoors in rainy weather or if freezing temperatures are expected before the coating dries. Under normal conditions this coating will dry for recoating or outdoor exposure in 24 to 48 hours, but it will remain soft for long periods.

To prevent checking and alligatoring when exposed to sunlight this coating must be topcoated with Coal Tar Emulsion Coating meeting SSPC-Paint 32.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.3.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifica-

Provided by : www.spic.ir Licensee: NISOC Library

tions is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not a requirement of this specification.

**9.1** The supplier should also furnish information on the volume solids and theoretical spreading rate (square feet per gallon for one mil of dry paint [square meters per liter for one micrometer of dry paint]).

**9.2** VOC information may be supplied on the label or the technical data sheet.

**9.3** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 34
May 1, 1996
Editorial Changes September 1, 2000

# SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 34

## Water-Borne Epoxy Topcoat for Steel Surfaces

## 1. Scope

**1.1** This specification covers an ambient-cured, two-component water-borne epoxy coating that is intended for use as a finish coat in multicoat water-borne epoxy systems for steel.

**1.2** Topcoats are categorized according to performance levels (Sections 2.3, 6, and 7).

**1.3** Topcoats meeting this specification, when used with an appropriate primer, are suitable for exposures in Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water), 2B (frequently wet by salt water), and 3C (chemical exposure, alkaline).

**1.4** The specified topcoat is intended for application by brush, spray, or roller over primed surfaces prepared in accordance with the manufacturer's recommendations. It is suitable for use as a water-borne epoxy topcoat in a two-coat system or as an intermediate coat and topcoat in a three-coat system, to be applied in accordance with the manufacturer's recommendations.

## 2. Description

**2.1 COMPOSITION**

**2.1.1** The topcoat specified is based on a reactive oxirane (epoxy) functional resin with amine or acid functional curing agents.

**2.1.2** The major volatile component by weight is water. Refer to ASTM D 3792 or ASTM D 4017 for determination of the water content of paints.

**2.2 VOLATILE ORGANIC COMPOUND (VOC) CONTENT:** Consult applicable government regulations to determine maximum allowable VOC content and the proper VOC test method for a particular application. The supplier should provide VOC information on the coating as supplied (in the container) and as applied (in the field after recommended thinning).

**2.3 PERFORMANCE LEVEL:** The finish coat shall be classified according to exposure performance achieved as follows, based on testing of primed systems as specified.

**Level 1** Accelerated Testing (Section 6)
**Level 2** 12-Month Exterior Exposure (Section 7.2)
**Level 3** 36-Month Exterior Exposure (Section 7.3)

**2.3.1** If no performance level is specified, Level 2 is assumed.

## 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC SPECIFICATIONS:**

| | |
|---|---|
| **Paint 28** | Water-Borne Epoxy Primer for Steel Surfaces |
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness with Magnetic Gages |
| **SP 10** | Near-White Blast Cleaning |
| **VIS 2** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **A 36** | Specification for Carbon Structural Steel |
| **B 117** | Practice for Operating Salt Spray (Fog) Apparatus |
| **D 523** | Test Method for Specular Gloss |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 609** | Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products |
| **D 610** | Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces |
| **D 714** | Test Method for Evaluating Degree of Blistering of Paints |

Provided by : www.spic.ir Licensee: NISOC Library

**D 823** Practices for Producing FIlms of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels
**D 1200** Test Method for Viscosity by Ford Viscosity Cup
**D 1475** Test Method for Density of Paint, Varnish, Lacquer, and Related Products
**D 1654** Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
**D 2243** Test Method for Freeze-Thaw Resistance of Water-Borne Coatings
**D 2244** Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates
**D 2369** Test Method for Volatile Content of Coatings
**D 2574** Test Method for Resistance of Emulsion Paints in the Container to Attack by Microorganisms
**D 3359** Test Methods for Measuring Adhesion by Tape Test
**D 3363** Test Method for Film Hardness by Pencil Test
**D 3792** Test Method for Water Content of Water-Reducible Paints by Direct Injection into a Gas Chromatograph
**D 3924** Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials
**D 3925** Practice for Sampling Liquid Paints and Related Pigmented Coatings
**D 3960** Practice for Volatile Organic Compound (VOC) Content of Paints and Related Coatings
**D 4017** Test Method for Water in Paints and Paint Materials by Karl Fischer Method
**D 4060** Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
**D 4417** Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
**D 4585** Practice for Testing the Water Resistance of Coatings Using Controlled Condensation
**G 92** Practice for Characterization of Atmospheric Test Sites

**3.6 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

**Z129.1** Hazardous Industrial Chemicals—Precautionary Labeling

**3.6 NACE INTERNATIONAL STANDARD:**

**RP 0287** Field Measurement of Surface Profile of Abrasive Blast Cleaned Surfaces Using Replica Tape

**3.7 U.S. ENVIRONMENTAL PROTECTION AGENCY:**

**40 CFR Chapter 1, Part 60, Appendix A, Method 24—**Determination of Volatile Matter Content, Density, Volume Solids and Weight Solids of Surface Coatings

## 4. Composition

**4.1** The manufacturer is given latitude in the selection of materials, provided the topcoat system meets the requirements of the specification. Materials shall be those used in good commercial practice and entirely suitable for the purpose intended under normal conditions.

**4.2** The coating shall comply with applicable state and local VOC regulations as measured by EPA Method 24, ASTM D 3960, or other required methods. If no method is specified, use EPA Method 24. The supplier should provide information on the coating as supplied in the container and as thinned for application if VOC is to be added in thinning.

## 5. Standard Testing Conditions

**5.1** The standard testing conditions shall be in accordance with the standard atmosphere in ASTM D 3924, unless indicated otherwise. Standard temperature shall be 23 ± 2 °C (73.5 ± 3.5°F), and standard relative humidity 50 ± 5%.

**5.2** The standard substrate shall be 3.2 mm (1/8 in.) thick ASTM A 36 hot rolled steel abrasive blasted in accordance with SSPC-SP 10 to a profile of 50 ± 13 micrometers (2.0 ± 0.5 mils) unless indicated otherwise. Measure blast profile in accordance with ASTM D 4417 or NACE RP0287. Sealed and primed chart paper may be used to perform the film irregularity test discussed in Section 6.10.

**5.3** The substrate shall be primed with a compatible water-borne epoxy primer, as defined in SSPC-Paint 28, Section 5.3.

**5.4** The topcoat shall be applied following the manufacturer's recommendations for cure times and method of application.

## 6. Laboratory Performance Testing Requirements

**6.1** For Level 1 (Accelerated Testing), the coating shall meet the requirements of Sections 6.2 through 6.13. For Level 2 and Level 3 (Exterior Exposure), the coating

Provided by : www.spic.ir Licensee: NISOC Library

shall meet the requirements of Section 7 in addition to the requirements in Section 6.

**6.2 RESISTANCE TO MICROORGANISMS IN CONTAINER:** The coating shall be resistant to attack by microorganisms when tested in accordance with ASTM D 2574.

**6.3 FREEZE-THAW RESISTANCE:** Test each of the components separately in accordance with ASTM D 2243. At the end of three cycles there shall be no gelling, coagulation, lumps, coarse particles, or viscosity change in excess of 10 Krebs Units per ASTM D 562.

**6.4 PACKAGE STABILITY:** Perform the following tests: Place each component in an appropriate closed container (i.e., a lined metal or plastic can) in an oven for one month at 52° ± 1°C (125° ± 2°F). There shall be no viscosity change in excess of 10 Krebs Units when tested in accordance with ASTM D 562. The cured film shall produce a uniform appearance when applied at recommended film thicknesses.

**6.5 MECHANICAL STABILITY:** Test each component separately by filling a one-quart friction top can three-quarters full and closing the can tightly. Rotate on a jar roller for one week at 120-170 rpm. There shall be no indication of separation, coagulation, or changes in viscosity greater than 10 Krebs Units (per ASTM D 562).

**6.6 POT LIFE:** The term "pot life," as used for solvent-borne or solventless epoxies, generally does not have the same meaning for water-borne epoxies. The usable pot life of mixed components of water-borne epoxies cannot be determined simply by measuring changes in viscosity. Thoroughly mix together both components of the coating to yield one quart of mixed material. Allow this mixture to stand at the standard conditions specified in Section 5.1 for the pot life specified by the manufacturer. At the end of this time period, the mixed coating shall show no evidence of gelation and must meet the requirements of Sections 6.7 through 6.13. The cured film shall show no significant change in color or gloss as measured by ASTM D 2244 and D 523, respectively. These methods contain definitions of the degree of difference between original color or gloss and final color or gloss deemed to be significant by visual observation.

**6.7 LABORATORY APPLICATION PROPERTIES:** Thoroughly mix together both components of the coating. Allow the mixed material to stand for the manufacturer's specified induction time (if any). Apply the coating in accordance with the manufacturer's recommendations to a primed, vertical steel substrate under the standard conditions specified in Sections 5.1 through 5.4. Allow the coating to dry in a well-ventilated room or chamber free from drafts and dust in diffuse light. There shall be no runs, sags, streaks, laps, pinholing, or cratering.

**6.8 ADHESION:** Apply one coat of the coating to a primed panel prepared as specified in Section 5.2. Condition the panel for seven days at standard temperature and humidity (Section 5.1). Evaluate adhesion in accordance with ASTM D 3359, Method B, using one mm spacing. A rating of 5B is required.

**6.9 RECOAT TESTS:** Apply a second coat of topcoat to a panel prepared as defined in Section 6.7, following the manufacturer's recommendations. There shall be no picking up or rolling up of the previous coat(s) during application. After 24 hours, the system should appear smooth and uniform.

**6.10 FILM IRREGULARITY:** Apply one coat of the topcoat by the drawdown method to a 10 cm x 20 cm (4 in. x 8 in.) primed panel, as prepared in Section 5.2, to produce the manufacturer's recommended DFT. Sealed and primed chart paper may also be used as a substrate for this test. Allow to dry for 24 hours under the standard conditions specified in Section 5.1. There shall be no mud-cracking, alligatoring, or other film irregularities noted upon examination.

**6.11 RUST AND BLISTER RESISTANCE:**

**6.11.1 Sample Preparation:** Spray apply coat(s), per the manufacturer's recommendation, to four primed panels prepared in accordance with the standard testing conditions specified in Sections 5.1 through 5.4. Allow the system to dry for up to 14 days. Seal all edges and the back side of each panel with a coating that will provide the necessary protection to these surfaces. Scribe a five cm (two inch) vertical line through the lower middle portion of the panels to expose the underlying metal before testing. The conditions of making the scribe shall conform to ASTM D 1654.

**6.11.2 Salt Spray Test:** Expose duplicate panels in the salt fog cabinet for 800 hours according to ASTM B 117. At the end of the 800 hours, immediately examine the panels for rusting, blistering, and creepage. The rusting shall not exceed 8 according to SSPC-VIS 2 or ASTM D 610. The blistering shall not exceed 8F according to ASTM D 714. Check creepage from the scribe according to ASTM D 1654, Procedure A. A minimum rating of 7 (1.6 mm [1/16 in.] or less) is required. After examining the panels, immediately remove the coating film with a suitable organic solvent as recommended by the manufacturer. If scraping is necessary to remove the coating film, do so using a piece of soft wood such as a tongue depressor. Do not use a metal spatula or a razor blade. Examine the bare steel substrate. Rusting shall not exceed 8 as judged by the

Provided by : www.spic.ir Licensee: NISOC Library

criteria listed above, and rust creep shall not exceed 3.2 mm (1/8 inch) from the center of the scribe.

**6.11.3 Condensation:** Expose the other pair of duplicate panels in a Cleveland Condensing Cabinet for 750 hours at 38°C (100°F) according to ASTM D 4585. At the end of 750 hours, immediately examine the panels for rusting, blistering, and creepage. The rusting shall not exceed 8 according to SSPC-VIS 2 or ASTM D 610. The blistering shall not exceed 8F according to ASTM D 714. Check creepage from the scribe according to ASTM D 1654, Procedure A. A minimum rating of 7 (1.6 mm [1/16 inch] or less) is required. After examining the panels, immediately remove the coating film, using a suitable organic solvent as recommended by the manufacturer. If scraping is necessary, do so using a piece of soft wood such as a tongue depressor. Do not use a metal spatula or a razor blade. Examine the bare steel substrate. Rusting shall not exceed 8 as judged by the criteria listed above, and rust creep shall not exceed 3.2 mm (1/8 in.) from the center of the scribe.

**6.12 ABRASION RESISTANCE:** Apply two coats of the topcoat to three primed steel panels meeting the size requirements noted in Section 6.1 of ASTM D 4060. Allow the panels to dry for up to 14 days according to the standard testing conditions specified in Sections 5.1 through 5.4. An average weight loss of no more than 140 mg is required when tested according to ASTM D 4060 with CS17 wheels for 1000 cycles.

**6.13 EARLY WATER RESISTANCE:** Apply one coat of the topcoat in accordance with the standard testing conditions specified in Sections 5.1 through 5.3 within 24 hours after priming. After six hours, immerse one-half of the panel in distilled water for five minutes. Remove and allow the system to condition for 10 minutes at standard temperature (see Section 5.1). The exposed section of the panel shall have the same hardness, gloss, and color as the unexposed section when checked according to ASTM D 3363, D 523, and D 2244, respectively.

## 7. Exterior Performance Requirements

**7.1** Two sets of triplicate panels shall be prepared as specified in Section 6.11.1.

**7.2 LEVEL 2 EXTERIOR EXPOSURE:** Triplicate test specimens shall be exposed for a minimum of 12 months on a test fence at an industrial or marine exposure site having a minimum annual mean precipitation of 635 mm (25 in.) per year. Other criteria for classifying the environment such as corrosion rate of bare steel or bare zinc, or mean annual temperature, may also be required when agreed to by purchaser and supplier. Each specimen shall meet the following requirements:

- Rust rating of 8 or better in accordance with SSPC VIS 2/ASTM D 610
- Maximum scribe undercutting of 1.6 mm (1/16 in.) per ASTM D 1654

**7.3 LEVEL 3 EXTERIOR EXPOSURE:** Triplicate test specimens shall be exposed for a minimum of 36 months on a test fence at an industrial or marine exposure site having a minimum annual mean precipitation of 635 mm (25 in.) per year. Other criteria for classifying the environment such as corrosion rate of bare steel or bare zinc, or mean annual temperature, may also be required when agreed to by purchaser and supplier. Each specimen shall meet the following requirements:

- Rust rating of 8 or better in accordance with SSPC VIS 2/ASTM D 610
- Maximum scribe undercutting of 3 mm (1/8 in.) per ASTM D 1654

## 8. Material Quality Assurance

**8.1** The manufacturer should measure and record batch testing information that would allow certification that a batch meets the necessary standards established by the manufacturer for the topcoat as tested per Section 6.

**8.2 CONDITION IN CONTAINER:** Each component as received shall show no evidence of livering, skinning, or hard settling of the pigment. The inside of the container shall not be corroded. The material shall be easily dispersed in the liquid portion by hand stirring to form a smooth, homogeneous coating.

**8.3 COLOR:** The color shall be as specified in the procurement documents.

**8.4 POT LIFE:** Mix the topcoat as specified in Section 6.6. Allow the mixed topcoat to stand at standard conditions (Section 5.1) for the pot life specified by the manufacturer. At the end of this time period, the mixed topcoat shall show no evidence of gelation or change in color or gloss once applied and cured.

**8.5 VISCOSITY:** The viscosity of the mixed topcoat shall be determined in accordance with ASTM D 62. Variance shall be within ± 5 Krebs Units or equivalent units of another viscometer of the viscosity of the previously qualified topcoat.

For viscosities lower than 55 KU, a number 4 Ford Cup shall be used in accordance with ASTM D 1200. Variations shall be within ± 5 seconds of the viscosity of the previously qualified coating.

**8.6 DENSITY:** Density of the mixed topcoat shall be determined in accordance with ASTM D 1475. Variance

Provided by : www.spic.ir Licensee: NISOC Library

shall be within ± 50 g/l (0.4 lb/gal) of the nominal density of the previously qualified topcoat.

**8.7 SOLIDS BY WEIGHT:** Solids by weight of the mixed topcoat shall be determined in accordance with ASTM D 2369. Variance shall be within ± 2% of the nominal percent solids by weight of the previously qualified topcoat.

## 9. Labeling

**9.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coatings Association (NPCA) Paint Industry Labeling Guide.

**9.2 MARKING OF CONTAINERS:** Each container of each component shall be legibly marked with the following information:

Name: Water-Borne Epoxy Topcoat for Steel Surfaces
Specification: SSPC-Paint 34
Component:
Color:
Lot Number:
Batch Number:
Stock Number:
Date of Manufacture:
Quantity of Coating in Coating in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**9.3 DIRECTIONS FOR USE:** Directions for use of water-borne epoxy topcoat must include information on storage, surface preparation, mixing, thinning, application, usable pot life, and recoatability.

## 10. Inspection

**10.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 12.5.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**10.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**10.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 11. Disclaimer

**11.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**11.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 12. Notes

Notes are not requirements of this specification.

**12.1** VOC information should be supplied on the label and the technical data sheet.

**12.2** ASTM D 3960 and EPA Method 24 are methods commonly used to determine VOC, but these methods may not be acceptable to all jurisdictions.

**12.3** The 250 meter (800-ft) lot at the LaQue Center, Wrightsville (Kure) Beach, NC and the Neville Island and coke works sites in Pittsburgh, with average bare steel corrosion rates of 25 to 76 micrometers (one to three mils) per year based on panels exposed for 12 months, have been shown suitable for this specification's exterior exposure. The test coatings used to establish the performance requirement were evaluated at these test sites. Specific details of the rust and undercutting results are available from SSPC.

**12.4** The supplier should also furnish information on the volume solids and the theoretical spreading rate (square meters per liter for one micrometer of dry coating [square feet per gallon for one mil of dry coating]).

**12.5** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 35

## Medium Oil Alkyd Primer (Air Dry/Low Bake)

## Type I and Type II

## 1. Scope

**1.1** This specification covers a French process zinc oxide, and medium oil alkyd primer designed for cold rolled sheet or unrusted hot rolled, blast cleaned structural steel. Recoat or dry-through time is 18 hours. It has good resistance to weathering.

**1.2** This paint is suitable for exposures in Environmental Zones 1A (interior, normally dry) and 1B (exterior, normally dry). It is intended for brush, roller, or spray application over new or unrusted steel surfaces prepared in accordance with SSPC-SP 6, "Commercial Blast Cleaning," or SSPC-SP 11, "Power Tool Cleaning to Bare Metal," or better (See Note 9.1). This primer is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel." If the primed steel is to be exposed to the weather, it should be topcoated as soon as practical.

## 2. Description

**2.1** This specification contains provisions to assure performance which is comparable to that customarily expected from paints containing lead and chromates. Type II has a lower percentage of volatile organic compounds (VOC) than Type I. (Details of the composition are given in Table 1 for Type I and in Table 2 for Type II.)

**2.2** Type I primer contains approximately 37% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 25 micrometer (1 mil) dry film thickness is 15 square meters/liter (590 square feet/U.S. gallon). Actual spreading rates can be significantly lower. On a calculated basis, the VOC is 492 grams per liter (4.1 pounds per gallon).

**2.2** Type II primer contains approximately 66% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 25 micrometer (1 mil) dry film thickness is 26 square meters/liter (1058 square feet/U.S. gallon). Actual spreading rates can be significantly lower. On a calculated basis, the VOC is 312 grams per liter (2.6 pounds per gallon).

## 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |
| **SP 11** | Power Tool Cleaning to Bare Metal |
| **Guide 7** | Guide for the Disposal of Lead-Contaminated Surface Preparation Debris |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 79** | Specification for Zinc Oxide Pigments |
| **D 185** | Test Methods for Coarse Particles in Pigments, Pastes, and Paints |
| **D 235** | Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent) |
| **D 522** | Test Methods for Mandrel Bend Test of Attached Organic Coatings |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 600** | Specification for Liquid Paint Driers |
| **D 605** | Specification for Magnesium Silicate Pigment (Talc) |
| **D 607** | Specification for Wet Ground Mica Pigments |
| **D 1208** | Test Methods for Common Properties of Certain Pigments |
| **D 1210** | Test Method for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**COMPOSITION**
**SSPC-Paint 35, Type I**

| INGREDIENTS | REQUIREMENTS Min. Wt. % | Max. Wt. % | TYPICAL COMPOSITION Wt. % | Vol. % | INGREDIENT STANDARDS ASTM | FEDERAL |
|---|---|---|---|---|---|---|
| PIGMENT*: (41.0 ± 2 wt. %) | | | | | | |
| Zinc Oxide | 9.0 | 11.0 | 4.1 | 0.9 | D 79, Dry Pigment, French Process | — |
| Iron Oxide (85% minimum $Fe_2O_3$) | 57.0 | — | 23.4 | 7.2 | D 3722/D 3724 | — |
| Magnesium Silicate | — | 23.0 | 9.4 | 4.2 | D 605 | — |
| Mica | 10.0 | 12.0 | 4.1 | 1.8 | D 607 | — |
| TOTAL PIGMENT: | 100 | | 41.0 | 14.1 | | |
| VEHICLE: (59.0 ± 2 wt. %) | | | | | | |
| Alkyd Resin Solids | 33.0 | — | 19.6 | 22.8 | — | TT-R-266, Type III |
| Solvent | — | 67.0 | 39.4 | 63.1 | D 235 | — |
| Driers | — | — | — | — | D 600, Non-Lead | — |
| TOTAL VEHICLE: | 100 | | 59.0 | 85.9 | | |
| TOTAL: | | | 100 | 100 | | |

*The composite pigment shall comply with the following:

| PROPERTY | METHOD | REQUIRED |
|---|---|---|
| pH | — | 7 to 8 |
| Specific Resistance of Leachate | ASTM D 2448 | 5000 ohm-cm minimum |

**D 1542** Test Method for Qualitative Detection of Rosin in Varnishes
**D 1640** Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
**D 2369** Test Method for Volatile Content of Coatings
**D 2371** Test Method for Pigment Content of Solvent-Reducible Paints
**D 2448** Test Method for Water-Soluble Salts in Pigments by Measuring the Specific Resistance of the Leachate of the Pigment
**D 2832** Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings
**D 3278** Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus
**D 3722** Specification for Natural Red and Brown Iron Oxide Pigments
**D 3724** Specification for Synthetic Brown Iron Oxide Pigment
**D 3734** Specification for High-Flash Aromatic Naphthas
**D 3925** Practice for Sampling Liquid Paints and Related Pigmented Coatings
**D 3951** Practice for Commercial Packaging
**D 4400** Test Methods for Sag Resistance of Paints Using a Multinotch Applicator

**3.6 FEDERAL SPECIFICATIONS AND STANDARDS:**

**3.6.1 Standard Specifications for Ingredients**

**TT-R-266** Resin, Alkyd: Solutions

**3.6.2 Federal Specification and Test Method Standard No. 141**

**Method 3011** Condition in Container
**Method 3021** Skinning (Partially Filled Container)
**Method 4321** Brushing Properties
**Method 4331** Spraying Properties
**Method 4541** Working Properties and Appearance of Dried Film

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

**ANSI Z129.1** Hazardous Industrial Chemicals —Precautionary Labeling

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1 for Type I and in Table 2 for Type II.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**COMPOSITION**
**SSPC-Paint 35, Type II**

| INGREDIENTS | REQUIREMENTS Min. Wt. % | Max. Wt. % | TYPICAL COMPOSITION Wt. % | Vol. % | INGREDIENT STANDARDS ASTM | FEDERAL |
|---|---|---|---|---|---|---|
| PIGMENT*: (55.0 ± 2 wt. %) | | | | | | |
| Zinc Oxide | 10.0 | 12.0 | 5.5 | 1.6 | D 79, Dry Pigment, French Process | — |
| Iron Oxide (85% minimum $Fe_2O_3$) | 57.0 | — | 31.4 | 12.7 | D 3722/D 3724 | — |
| Magnesium Silicate | — | 23.0 | 12.6 | 7.4 | D 605 | — |
| Mica | 10.0 | 12.0 | 5.5 | 3.2 | D 607 | — |
| TOTAL PIGMENT: | | 100 | 55.0 | 24.9 | | |
| VEHICLE: (59.0 ± 2 wt. %) | | | | | | |
| Alkyd Resin Solids | 59.0 | — | 26.5 | 40.7 | — | TT-R-266, Type III |
| Aromatics/Other Solvents | — | 41.0 | 18.5 | 34.4 | D 3734 for Aromatics | — |
| Driers | — | — | — | — | D 600, Non-Lead | — |
| TOTAL VEHICLE: | | 100 | 45.0 | 75.1 | | |
| TOTAL: | | | 100 | 100 | | |

*The composite pigment shall comply with the following:

| PROPERTY | METHOD | REQUIRED |
|---|---|---|
| pH | — | 7 to 8 |
| Specific Resistance of Leachate | ASTM D 2448 | 5000 ohm-cm minimum |

**4.2** The primers based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. No rosin or rosin derivatives may be used. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added.

**4.3** The primers shall conform to the composition (analysis) requirements of Table 3.

**4.4** The resin for Type 2 shall be a medium length oil alkyd designed for low-VOC use. The physical characteristics of the resin shall be as follows:

Type: Pure Drying Alkyd Resin
Volatiles: Manufacturer may select a solvent system appropriate to meet VOC requirements of the paint.
Viscosity, Gardner/Holdt: U-Z
Color Gardner-Delta, max.: 10
Acid number, solids, max.: 12
Density of solution, avg.: 1020 g/l (8.5 lb/gal)
Flash point, (SFCC), typical, min.: 38°C (100°F)

## 5. Properties

**5.1** The primers for Type I and Type II shall meet the requirements of Tables 3 and 4 and of Sections 5.2 through 5.12.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**5.3 COLOR:** The color shall be typical of the specified mixture of zinc oxide and red or brown iron oxide.

**5.4 COMPATABILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when two volumes of the paint are slowly mixed with one volume of solvent that was used by the manufacturer in production of the alkyd resin.

**5.5 WORKING PROPERTIES:** The paint shall be easily applied by brush, roller, or spray when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running or sagging during application or while drying.

**5.6 CONDITION IN CONTAINER:** The paint shall show no thickening, curdling, gelling, or hard caking when tested as specified in FED-STD-141, Method 3011, after storage for six months from the date of delivery, in a full, tightly covered container, at a temperature of 10-43°C (50-110°F).

**5.7 SKINNING:** There shall be no skinning in a three-quarters filled closed container after 48 hours when tested in the standard manner specified in FED-STD-141, Method 3021.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 3**
**ANALYSIS**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | REQUIREMENTS Max. Wt. % | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Pigment content | | | | |
| Type I | 39.0 | 43.0 | D 2371 | — |
| Type II | 53.0 | 57.0 | D 2371 | — |
| Volatiles | | | | |
| Type I | — | 40.9 | D 2369 | — |
| Type II | — | 19.3 | D 2369 | — |
| Nonvolatile vehicle | | | | |
| Type I | 18.8 | — | D 2832 | — |
| Type II | 25.4 | — | D 2832 | — |
| Uncombined water | — | 1.0 | D 1208 | — |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 1.5 | D 185 | — |
| Rosin or rosin derivatives | — | 0 | D 1542 | — |

**TABLE 4**
**PROPERTIES**

| CHARACTERISTICS | REQUIREMENTS Min. | REQUIREMENTS Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Consistency* shear rate 200 rpm | | | | |
| Grams | 175 | 225 | D 562 | — |
| Krebs units | 77 | 86 | D 562 | — |
| Density, kg/l (lb/US gal) | | | | |
| Type I | 1.25 (10.4) | — | D 1475 | — |
| Type II | 1.66 (13.8) | — | D 1475 | — |
| Fineness of grind, Hegman units | 3 | — | D 1210 | — |
| Drying time, hours | | | | |
| Tack free | — | 7 | D 1640 | — |
| Dry hard | — | See Section 6.4 | D 1640 | — |
| Flash point, °C (°F) | 38 (100) | — | D 3278 | — |
| Sag resistance, mm (mils) | 0.18 (7) | 0.25 (10) | D 4400 | — |

*Consistency 48 hours or more after manufacture.

**5.8 SALT CONTAMINATION:** Content of salt contamination shall have been minimized by the incorporation of only high purity materials. The specific resistance of the aqueous leachate of the composite of the pigments in required proportions shall be a minimum of 5000 ohm-cm when tested in accordance with ASTM D 2448.

**5.9 FLEXIBILITY:** After baking 24 hours at 93°C (200°F) the film shall show no cracking when suddenly chilled to 0°C (32°F) and bent sharply on itself through 180 degrees over a 6 mm (1/4 inch) mandrel in the time of 1 to 2 seconds as described in ASTM D 522, Method A. The film on the bent part of the panel shall show no visible cracking or disbonding.

**5.11 CURING:** The primers shall dry to handle within 3/4 hour when baked at 121°C (250°F). Upon recoating after curing, no blistering, wrinkling, or other evidence of lifting shall occur.

**5.12 WATER RESISTANCE:** A 51 μm (2 mil) dry film, air dried 96 hours, immersed in deionized water 18 hours at 30°C (86°F) shall show no wrinkling or blistering immediately after removal from water. After a two hour recovery, the film shall show only very slight whitening and dulling.

## 6. Labeling

**6.1** Refer to ANSI Standard Z129.1. Other guidelines can be found in the National Paint and Coating Association (NPCA) “Paint Industry Labeling Guide.”

Provided by : www.spic.ir Licensee: NISOC Library

**6.2 MARKING OF CONTAINERS:** Each container shall be legibly marked with the following information:

Name: Medium Oil Alkyd Primer, Air Dry/Low Bake, Type I (or Type II)
Specification: SSPC-Paint 35
Color: Red or Brown Iron Oxide
Lot number:
Batch number:
Stock Number:
Date of Manufacturer:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
VOC Content:
Manufacturer's Name and Address:

**6.3 PACKAGING:** Material shall be packaged and labeled in accordance the requirements of ASTM D 3951 unless otherwise specified.

**6.4 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of
Medium Oil Alkyd Primer, Air Dry/Low Bake

This paint is intended for use as a primer over blast cleaned steel in atmospheric exposure; on previously corroded steel it will perform better if the steel is blast cleaned and then salts are extracted from corrosion pits on the surface. The steel surfaces shall be prepared in accordance with SSPC-SP 6 or SSPC-SP 11 or better. Salt contamination, oil, and grease shall be removed to the fullest extent practical, as residues of salt contamination, oil, and grease remaining on the surface will result in decreased paint performance.

Mix paint thoroughly before use. If the pigment has settled, pour off most of the liquid. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring contents to a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

The thinning of paint will change the VOC level. For roller, brush, or airless spray application, no thinning should be necessary. A minimum amount of thinning may be necessary for conventional air spray.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 50 micrometers (2 mils) dry. The surface to be painted shall be dry; the surface temperature shall be at least 3°C (5°F) above the dew point; and the temperature of the air shall be over 4°C (40°F). Do not paint outdoors in rainy weather or if freezing temperatures are expected before the paint dries.

Allow paint at least 18 hours drying time before recoating. Alternatively, bake at 121°C (250°F) for 45 minutes before handling.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.2.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The degrees of surface preparation SSPC-SP 5 and SSPC-SP 10 are better than SSPC-SP 6 and SSPC-SP 11.

Provided by : www.spic.ir Licensee: NISOC Library

**9.2** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

**9.3** The extraction of chlorides and other anions from corrosion pits in severe corrosivity areas of the structure is recommended.

**9.4** Handle wastes in accordance with federal, state and local government regulations. See SSPC Guide 7, "Guide for the Disposal of Lead-Contaminated Surface Preparation Debris."

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 36

## Two-Component Weatherable Aliphatic Polurethane Topcoat, Performance-Based

### 1. Scope

**1.1** This specification covers the requirements for a high performance two-component UV-stable polyurethane topcoat (ASTM D 16, Type V polyurethane). It is intended for a topcoat that provides excellent color and gloss retention, not for thick section elastomeric coatings.

**1.2** Coatings meeting the requirements of this specification are generally suitable for exposures in environmental zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water, excluding immersion), 2B (frequently wet by salt water, excluding immersion), 3B (chemical exposure, neutral), and 3C (chemical exposure, alkaline).

**1.3** The specified coating is intended for application by brush, spray, or roller. It is generally applied over a primer or intermediate coating.

### 2. Description

**2.1** This coating is typically based on a hydroxyl functional polyol resin and an aliphatic polyisocyanate co-reactant.

**2.2 WEATHERING LEVELS:** This specification contains three levels of accelerated and South Florida weathering performance. Table 1 specifies the amount of time the coating must perform before noticeable change in order to achieve the defined performance level. Polyurethane topcoats are available in a wide range of color and gloss. Procurement documents shall state the desired level of performance, exposure method (in accordance with Table 1), color and gloss. For example, a specifier may require Level 2 Florida exposure, initial gloss greater than 80, matched to a specific color. A certain level of accelerated weathering does not necessarily correspond to a particular level of atmospheric weathering and they need to be specified independently. These are two independent complementary tests for measuring coating performance. If no level is specified, Level 3 will be assumed.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.6, and form a part of this specification. A standard marked with an asterisk (*) is referenced only in the Notes, which are not requirements of this specification.

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

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

**3.4 SSPC STANDARD:**

**Guide 13** Guide for the Identification and Use of Industrial Coating Materials in Computerized Product Databases

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

**D 16** Terminology Relating to Paint, Varnish, Lacquer, and Related Products

**Table 1**
**Time Corresponding to Each Performance Level**

| | Accelerated UV-A | Florida Exposure |
|---|---|---|
| | Hours to noticeable change* | Months to noticeable change* |
| Level 1 | 500 to 999 | 12 to 23 |
| Level 2 | 1000 to 1999 | 24 to 48 |
| Level 3 | 2000 or more | 48 or more |

* Noticeable change is defined as a gloss loss of 30 units measured at a 60° angle (washed with a 0.1 percent solution of mild detergent) or a color change of greater than 2.0 ΔE* (C.I.E. 1976 L*a*b*)

Provided by : www.spic.ir Licensee: NISOC Library

| | | |
|---|---|---|
| | **D 523** | Test Method for Specular Gloss |
| * | **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| * | **D 968** | Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive |
| | **D 1014** | Practice for Conducting Exterior Exposure Tests of Paints on Steel |
| | **D 1259** | Test Methods for Nonvolatile Content of Resin Solutions |
| * | **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| * | **D 1308** | Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes |
| | **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| * | **D 1535** | Practice for Specifying Color by the Munsell System |
| * | **D 1640** | Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature |
| | **D 1849** | Standard Method for Package Stability of Paint |
| | **D 2244** | Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinate |
| | **D 2369** | Test Method for Volatile Content of Coating |
| * | **D 2371** | Test Method for Pigment Content of Solvent-Reducible Paints |
| * | **D 2621** | Test Method for Infrared Identification of Vehicle Solids from Solvent-Reducible Paints |
| | **D 2698** | Test Method for the Determination of Pigment Content of Solvent-Reducible Paints by High Speed Centrifuging |
| | **D 2794** | Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact) |
| * | **D 3359** | Test Methods for Measuring Adhesion by Tape Test |
| * | **D 3719** | Test Method for Quantifying Dirt Collection on Coated Exterior Panels |
| * | **D 4214** | Test Methods for Evaluating Degree of Chalking of Exterior Paint Films |
| | **D 4587** | Practice for Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water-Exposure Apparatus |
| * | **D 5402** | Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs |
| * | **D 5590** | Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay |

**3.5 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals - Precautionary Labeling |

**3.6 FEDERAL SPECIFICATIONS AND STANDARDS**:

| | | |
|---|---|---|
| | **FED-STD-141** | Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing |
| * | **Method 3011** | Condition in Container |
| | **Method 4321** | Brushing Properties |
| | **Method 4331** | Spraying Properties |
| | **Method 4541** | Working Properties and Appearance of Dried Film |

## 4. Composition Requirements

**4.1** The manufacturer is given wide latitude in the selection of raw materials and manufacturing processes. (See Note 11.1.)

**4.2 RESIN REQUIREMENT:** The curing agent shall be an aliphatic polyisocyanate. The total coating binder solids shall be made up of at least 17% polyisocyanate by weight. See Annex 1 for the theoretical calculation and the method for actual determination.

## 5. Requirements of Liquid Coating

**5.1 PACKAGE STABILITY:** Package stability shall be tested in accordance with ASTM D 1849. Storage conditions shall be 30 days at 52 ± 1°C (125 ± 2 °F). A change in consistency of greater than 10 Krebs units or noncompliance with the application requirements shall be cause for rejection.

**5.2 APPLICATION PROPERTIES:** All guidance provided by the manufacturer regarding mixing of multi-component products, thinning requirements, induction times, and special application requirements shall be followed. The coating shall be easily applied by brush, roller, or spray when tested in accordance with Fed. Std. 141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging during application or while drying.

## 6. Weathering Requirements

**6.1 WEATHERING RESISTANCE:** Two weathering test procedures are specified below. Test data may not be available for the desired color and gloss specified. Performance levels are established using whites and light colors. It is left to the discretion of the specifier whether to accept

Provided by : www.spic.ir Licensee: NISOC Library

Florida data from a similar color or to use UV-A data in lieu of Florida weathering data.

**6.1.1 Accelerated Weathering:** Accelerated weathering shall be performed in accordance with ASTM D 4587, Procedure B. Test panels shall have a primer/intermediate coat as recommended by the manufacturer.

**6.1.2 South Florida Weathering:** South Florida weathering shall be performed in accordance with ASTM D 1014 (45 degrees south exposure, washed with mild detergent.) Test panels shall have a primer/intermediate coat as recommended by the manufacturer.

**6.1.3** Application shall be according to manufacturer's written recommendations. A minimum of three panels shall be exposed. Clear coatings must be tested over the intended basecoat. 60 degree gloss shall be measured according to ASTM D 523 and tristimulus color measured according to ASTM D 2244 both initially and at the end of each level period. A change from initial gloss of less than 30 units or a change from initial color of less than 2.0 ΔE* (C.I.E. 1976 L*a*b*) shall be required to meet the Level as indicated in Table 2 below. Table 2 summarizes the tests of Section 6 as well as the minimum acceptance criteria.

## 7. Material Quality Assurance

**7.1** If the user chooses, tests may be used to determine the acceptability of a lot or batch of a qualified coating. (See Note 11.2.)

## 8. Labeling

**8.1** Labeling shall conform to ANSI Z129.1

**8.2** Technical data shall be provided for at least all data elements categorized as "essential" in SSPC-Guide 13.

## 9. Inspection

**9.1** All material supplied under this specification is subject to timely inspection by the purchaser or his authorized representative. The contractor shall replace such material as is found defective under this specification. (See Note 11.3.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**9.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**9.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 10. Disclaimer

**10.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**10.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

**Table 2**
**Summary of Performance Testing Results to be Reported**

| Exposure Test | Performance Level | Exposure Time | Measurement Test /Minimum Criteria | |
|---|---|---|---|---|
| | | | Color Change ASTM D 2244 | Gloss Loss ASTM D 523 |
| Accelerated Weathering ASTM D 4587 | Level 1 | 500 h | Color Change less than 2.0 ΔE* | Gloss Loss less than 30 |
| | Level 2 | 1000 h | | |
| | Level 3 | 2000 h | | |
| South Florida Weathering ASTM D 1014 | Level 1 | 12 mo | Color Change less than 2.0 ΔE* | Gloss Loss less than 30 |
| | Level 2 | 24 mo | | |
| | Level 3 | 48 mo | | |

Provided by : www.spic.ir Licensee: NISOC Library

## 11. Notes

Notes are not requirements of this specification.

**11.1 VOC CONTENT:** Each coating, after recommended thinning, must conform to published government regulations regarding volatile organic compound (VOC) content. VOC information should be supplied on the label or the technical data sheet. Various governmental agencies may have different VOC limits or use different methods of testing. The owner may modify this specification as necessary to specify a particular VOC content limit consistent with local regulations. Coatings meeting the composition and performance requirements of this specification usually have a VOC level between 0 and 450 g/L (0 and 3.75 lb/gal).

**11.2 QUALITY ASSURANCE TESTS:** The quality assurance tests are used to determine whether the supplied products are of the same type and quality as those originally tested and certified for acceptance. The selected tests should accurately and rapidly measure the physical and chemical characteristics of the coating necessary to verify that the supplied material is substantially the same as the previously accepted material. All of the quality assurance tests must be performed on the originally submitted qualification sample. The results of these tests are used to establish pass/fail criteria for quality assurance testing of supplied products.

**11.2.1 Establishing Quality Assurance Acceptance Criteria:** Many ASTM test methods contain precision and bias statements. Specification developers should be cognizant of the fact that these statements exist. Quality assurance test criteria should not be more stringent than the interlaboratory precision of the test methods used.

*Example:* A common quality assurance test is density (weight per gallon) as measured by ASTM D 1475. The interlaboratory reproducibility at the 95% confidence level tells us that any two measurements that differ by more than 1.8% should be considered suspect. This only represents the precision of the measurement technique and does not account for normal variances in the manufactured product.

The acceptable range for paint density must be stated. For example, a composition specification may state this requirement as 10.0 ± 0.2 lb/gal, 10.0 lb/gal ± 2%, or as a range from 9.8 to 10.2 lb/gal. The manufacturer of proprietary products should provide this information. Using these values, if the manufacturer's lab measures the density to be 9.8 lb/gal, the product meets the specification and the paint is shipped to the job. Because of the lab to lab variation of 1.8%, the user's lab may measure the density of this sample to be as low as 9.8 less 1.8% of 9.8 (= 9.6 lb/gal). Similarly for the high end, the manufacturer may measure density of 10.2 lb/gal while the user measures 10.2 + 1.8% (= 10.4 lb/gal). The pass/fail criteria for the user to accept a batch of paint should therefore be 9.6 to 10.4 lb/gal.

Where precision and bias data are not available for a given test method, determine the standard deviation of a minimum of five measurements taken on the originally tested and certified material. The pass/fail criterion is that the measurement of the test sample shall fall within two standard deviations of the target value. The contracting parties must agree on a target value.

**11.2.2 Quality Assurance Tests:** Quality assurance tests include but are not limited to: infrared analysis (ASTM D 2621), viscosity (ASTM D 562), weight per gallon (ASTM D 1475), total solids (ASTM D 2369), dry time (ASTM D 1640), percent pigment (ASTM D 2371), gloss (ASTM D 523), color (ASTM D 1535), condition in container (Fed. Std. 141, Method 3011), and odor (ASTM D 1296).

**11.3** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

## ANNEX

### 1. Theoretical Calculation for Percent Polyisocyanate by Weight in the Total Vehicle

This example is for the formulator who knows the composition of the coating. Consider just the resin component for this calculation.

| | Weight | Weight Solids |
|---|---|---|
| Polyol A | 100.00 | 70.00 |
| Aliphatic Polyisocyanate B | 30.00 | 27.00 |
| | 130.00 | 97.00 |

Fraction (Percent) of polyisocyanate in total vehicle = 27 ÷ 97 = 0.278 or 27.8% by weight.

### 2. Method for Determination of Percent Polyisocyanate in the Total Vehicle

**Part 1**

Determine the percent non-volatile content by weight, N, of the polyol component only (Component 1) by ASTM 2369.

Determine the percent pigment content by weight, P, of Component 1 by ASTM 2698 (part of ASTM 2369).

Subtract the pigment content from the non-volatile content of Component 1 to obtain the percent non-volatile by weight polyol content, R.

$$R = N - P$$

**Part 2**

Determine the percent vehicle content by weight of the polyisocyanate curing agent, I, in accordance with ASTM 1259.

Provided by : www.spic.ir Licensee: NISOC Library

**Part 3**

Obtain the volume mix ratio of Component 1 : Component 2 as supplied from the manufacturer's data sheet e.g., $vol_1$: $vol_2$

Measure the specific gravity of each component by ASTM D 1475.

Convert volume mix ratio to weight mix ratio by multiplying by the specific gravity of each component; e.g.,

$$vol_1 \times s.g._1 = wt_1 \quad \text{and} \quad vol_2 \times s.g._2 = wt_2$$

**Part 4**

Multiply the weight of each component in the weight ratio by their respective percent vehicle solids content by weight, R and I, to obtain the weight vehicle of each component; e.g.,

$$wt_1 \times R = vehicle_1 \quad \text{and} \quad wt_2 \times I = vehicle_2$$

Calculate % polyisocyanate in the binder by dividing the weight of Component 2 vehicle by the sum of the two vehicle solids; e.g.,

$$\% \text{ polyisocyanate} = \frac{vehicle_1}{vehicle_1 + vehicle_2} \times 100$$

**Appendix 1: Optional Laboratory Physical Tests of Applied Films**

Typical properties that might be expected of a quality polyurethane topcoat are described in Table 3 with corresponding ASTM test methods and suggested test requirements.

**Table 3**
**Typical Properties**

| Test | ASTM | Result (Units) | Typical Values |
|---|---|---|---|
| Adhesion | D 3359 | — | 4B or better |
| Direct impact resistance | D 2794 | inch-lbs | 30 inch-lbs or better |
| Abrasion resistance (falling sand) | D 968 | liters/mil | 15 liters/mil or greater |
| Solvent (MEK) resistance | D 5402 | number of double rubs | 50 to 150 DR for MEK |
| Accelerated fungal resistance | D 5590 | disfigurement rating | 5 to 10 where 10 is no disfigurement |
| Quantifying dirt collection on coated exterior panels | D 3719 | photographic standard | $\Delta E^* < 2.0$ |
| Evaluating degree of chalking of exterior paints | D 4214 | photographic standard rating method | 6 to 8 where 10 is no chalking |
| Effect of household chemicals on clear and pigmented organic finishes | D 1308 | — | No visual effects |

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 101
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION 101

## Aluminum Alkyd Paint
## Leafing (Type I) and Non-Leafing (Type II)

### 1. Scope

**1.1** This specification covers two types of aluminum alkyd paint for steel. Both have good weathering in rural, industrial, and marine atmospheres. They are also excellent paints for interiors. These paints are not intended for use over bare steel.

**1.2** These paints are suitable for exposures in Environmental Zones 1A (interior, normally dry) and 1B (exterior, normally dry) and are intended for brush or spray application over rust inhibitive priming paints, over themselves, or over other oleoresinous paints. Each paint is suitable as an intermediate or topcoat and is to be applied in accordance with SSPC PA 1, "Shop, Field, and Maintenance Painting of Steel."

**1.3** Two types are available under this specification. Type I covers a leafing aluminum paint intended as a finish paint and Type II covers a non-leafing aluminum paint intended as an intermediate coat to provide contrast with the Type I finish coat.

### 2. Description

**2.1** Type I aluminum alkyd paint consists of a two-component container with leafing-type aluminum paste separated from a long oil alkyd varnish vehicle. The aluminum paste is mixed with the alkyd varnish prior to use. Type II employs non-leafing aluminum, and is usually furnished in a single compartment container. As an intermediate coat it provides a contrast with the Type I finish coat without tinting. Details of the composition are given in Table 1.

**2.2** This primer contains approximately 40% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 1.5 mil (38 micrometers) dry film thickness is 430 square feet/U.S. gallon (10.5 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARD:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 154** | Guide for Testing Varnishes |
| **D 235** | Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent) |
| **D 480** | Test Methods for Sampling and Testing of Flaked Aluminum Powders and Pastes |
| **D 600** | Specification for Liquid Paint Driers |
| **D 962** | Specification for Aluminum Powder and Paste Pigments for Paints |
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1542** | Test Method for Qualitative Detection of Rosin in Varnishes |
| **D 1545** | Test Method for Viscosity of Transparent Liquids by Bubble Time Method |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 3278** | Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL STANDARDS:**

| | |
|---|---|
| **TT-R-266** | Resin, Alkyd: Solutions |
| **TT-T-291** | (Canceled) Thinner, Paint, Mineral Spirits, Regular and Odorless (Refer to A-A-2904) |

Provided by : www.spic.ir Licensee: NISOC Library

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 3011** | Condition in Container |
| **Method 3021** | Skinning (Partially Filled Container) |
| **Method 4053** | Nonvolatile Vehicle Content |
| **Method 4061** | Drying Time |
| **Method 4203** | Reducibility and Dilution Stability |
| **Method 4321** | Brushing Properties |
| **Method 4331** | Spraying Properties |
| **Method 4541** | Working Properties and Appearance of Dried Film |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals —Precautionary Labeling |

## 4. Composition

**4.1** Ingredients and proportions of the mixed paint shall be as specified in Table 1.

**4.2** The paint based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. No rosin or rosin derivatives may be used. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added.

**4.3** The alkyd varnish shall conform to the composition (analysis) requirements of Table 2.

## 5. Properties

**5.1** The alkyd varnish shall meet the requirements of Table 3 and Sections 5.2 through 5.17.

**5.2 ODOR:** The odor shall be normal for the materials permitted (ASTM D 1296).

**5.3 COLOR:** The color shall be less than "11" on the Gardner 1933 scale.

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when two volumes of the mixed paint are slowly mixed with one volume of mineral spirits (FED-STD-141, Method 4203).

**5.5 WORKING PROPERTIES:** The paint shall be easily applied by all three methods when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging after drying.

**5.6 CONDITION IN CONTAINER:** The ready-to-mix and ready-mixed paint shall show no gas evolution, thickening, curdling, gelling, or hard caking when tested as specified in FED-STD-141, Method 3011, after storage for six months from date of delivery, in a full, tightly covered container, at a temperature of 50-110°F (10 to 43°C).

**5.7 SKINNING:** There shall be no skinning in a threequarters filled closed container after 48 hours when tested in the standard manner specified in FED-STD-141, Method 3021.

**TABLE 1**
**COMPOSITION OF MIXED PAINT**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | REQUIREMENTS Max. Wt. % | INGREDIENT STANDARDS ASTM | INGREDIENT STANDARDS FEDERAL |
|---|---|---|---|---|
| PIGMENT: (20.3 ± 0.5 wt. %) | | | | |
| Aluminum Paste[1] | 100 | — | — | — |
| VEHICLE: (79 ± o.5 wt. %) | | | | TT-R-266, Type I |
| Alkyd Varnish Solids[2] | 50 | — | — | Class A |
| Mineral Spirit Thinner | — | 50 | D 235 | TT-T-291, Type I |
| Driers | — | — | D 600, Class B | — |

[1] See Sections 5.12 through 5.17.
[2] See Tables 2 and 3 for analysis and properties of alkyd varnish.



Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**ANALYSIS OF ALKYD VARNISH**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | Max. Wt. % | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Volatile | — | 50 | D 2369 | — |
| Nonvolatile vehicle calculated by difference | 50 | — | — | 4053 |
| Rosin or rosin derivatives | — | 0 | D 1542 | — |

**TABLE 3**
**PROPERTIES OF ALKYD VARNISH**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | Max. Wt. % | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Viscosity[1], Gardner Airbubble Viscometer | C | E | D 1545 | — |
| Weight per U.S. gallon, pounds | 7.9 (914 g/L) | 8.1 (974 g/L) | D 1475 | — |
| Drying time, hours | | | | |
| Set to touch | — | 4 | — | 4061 |
| Dry hard | — | 10 | D 154 | 4061 |
| Flash point, degrees F | 86 (30°C) | — | D 3278 | — |

[1]Viscosity 48 hours or more after manufacture.

**5.8 APPEARANCE OF DRIED FILM:** A dried film of the varnish shall be clear, smooth, and glossy.

**5.9 FLEXIBILITY:** A dried film (thickness 1.0 ± 0.2 mils, 25 ± 5 micrometers) of the varnish shall show no cracking when bent over a 1 /8" mandrel after 17 hours air dry, plus 24 hours bake at 215-225°F (102-107°C).

**5.10 WATER RESISTANCE:** Dried films, prepared as in Section 5.9, shall resist boiling water for ten minutes, and shall withstand immersion in distilled water for 24 hours. Upon removal after two hours drying, the film shall show no whitening, blistering, or loss of adhesion, but slight dulling is permissible.

**5.11 GASOLINE RESISTANCE:** After airdrying for 17 hours, plus a 24 hour bake at 220°F (104°C), the mixed paint shall show no detrimental film effects after a painted panel is immersed in gasoline for four hours.

**5.12** The aluminum paste for Type I leafing paint shall comply with the requirements of ASTM D 962, Type 2, Class B, with the exception that the total retained on a 325 mesh sieve shall be within the range of 4%-6%.

**5.13** Aluminum paste for Type II, non-leafing paint shall be equivalent in fineness to the standard lining grade as defined by ASTM D 962, Type 4, Class B. In addition it shall meet the composition and properties requirements of Table 4 and Sections 5.14 through 5.17.

**5.14** The aluminum pigment paste shall consist of commercially pure aluminum in the form of fine, polished flakes, and a suitable fatty lubricant or metallic soap lubricant combined with a volatile thinner. It shall contain no fillers or adulterants. There shall be no appreciable settling out of the metallic portion of the paste in the container, i.e., no free liquid shall be present.

**5.15** The test methods are those given in ASTM D 480.

**5.16** The aluminum paste shall be non-leafing. Two grams of the paste mixed with 25 ml of Leaf-Testing Vehicle (ASTM D 480) in a 250 cc beaker shall show no more than a trace of leafing on the surface of the vehicle. In doubtful cases, absence of leafing shall be confirmed by Section 5.17.

**5.17 GENERAL APPLICABILITY AND APPEARANCE:** The sample of aluminum paste to be tested may be compared with a sample mutually agreed upon by purchaser and seller.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 4**
**ANALYSIS OF NON-LEAFING ALUMINUM PASTE**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | Max. Wt. % | ASTM |
|---|---|---|---|
| Nonvolatile matter at 105-110°C | 65 | — | — |
| Easily extracted fatty and oily matter (lubricants) | — | 3.0 | — |
| Total impurities other than fatty and oily matter | — | 0.7 | — |
| Coarse particles and skins, as retained on standards 325 mesh screen | — | 1.0 | D 185 |
| Leafing | — | None | — |

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legible marked with the following information:

Name: Aluminum Alkyd Paint, Type I, Leafing (or Type II, Non-Leafing)
Specification: SSPC-Paint 101, Type I (or II)
Component:
Color: Aluminum
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be Required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of Aluminum Alkyd Paint

This paint is intended for use as an intermediate (Type II) or finish coat (Type I) over rust inhibitive primers on structural steel or over other oleoresinous paints. All oil, grease, dust, and loose or nonadherent paint shall be removed; oil and grease shall be removed to the fullest extent practical, as residues of oil and grease remaining on the surface will result in decreased paint performance. If the undercoat is damaged, the steel shall be spot-cleaned and spot-primed with rust inhibitive primer.

Mix paint thoroughly before use. If this paint is furnished in two components, add the aluminum paste to the mixing varnish in the ratio of two pounds of aluminum paste per gallon of the varnish vehicle (1 kg per 4.2 l). To mix the paste with the varnish, add a small amount of the varnish to sufficient aluminum paste in a large container. Thoroughly mix the aluminum paste with the small portion of varnish until a smooth, thin paste is achieved. Gradually add more of the varnish while stirring. Continue adding paste and mixing until all of the varnish is incorporated with the vehicle. Examine bottom of container for unmixed paste. Screen paint before applying. Mix only enough for one day's use. If this paint is furnished in a single component and the pigment has settled, pour off most of the liquid. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring contents to a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

Thin paint only if necessary, using only mineral spirits or turpentine. For brush application under normal conditions, no thinnings should be necessary. For spray applications add up to one pint of thinner per gallon of paint when necessary.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 1.5 mils (38 micrometers) dry or approximately 4.0 mils (102 micrometers) wet. The surface to be painted shall be dry; the surface temperature shall be at least 5°F (3°C) above the dew point, and the temperature of the air shall be over 40°F (4°C). Do not paint outdoors in rainy weather or if freezing temperatures are expected before the paint dries.

Allow paint at least a drying time of 24 hours in good weather before recoating.

NOTE: This paint is not intended to be used as a priming coat next to bare steel.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or

Provided by : www.spic.ir Licensee: NISOC Library

his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. In no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

8.2 This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 102

## Black Alkyd Paint

### 1. Scope

**1.1** This specification covers a black alkyd high gloss paint for steel. It has good weathering in rural, industrial, and marine atmospheres. It is also an excellent general purpose paint for use in interior locations.

**1.2** This paint is suitable for exposures in Environmental Zones IA (interior, normally dry) and 1B (exterior, normally dry) and is intended for brush or spray application over rust inhibitive priming paints, over itself, or over other oleoresinous paints. This paint is suitable as an intermediate or topcoat and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

### 2. Description

**2.1** The good weathering ability of this paint is the result of its alkyd vehicle. Details of the composition are given in Table 1.

**2.2** This primer contains approximately 37% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 1.5 mil (38 micrometers) dry film thickness is 395 square feet/U.S. gallon (9.7 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARD:**

**PA 1** Shop, Field, and Maintenance Painting of Steel

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

**D 185** Test Methods for Coarse Particles in Pigments, Pastes, and Paints
**D 235** Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
**D 523** Test Method for Specular Gloss
**D 561** Specification for Carbon Black Pigment for Paint
**D 562** Test Method for Consistency of Paints Using the Stormer Viscometer
**D 600** Specification for Liquid Paint Driers
**D 1208** Test Methods for Common Properties of Certain Pigments
**D 1296** Test Method for Odor of Volatile Solvents and Diluents

**TABLE 1**
**COMPOSITION**

| INGREDIENTS | REQUIRED Min. Wt. % | REQUIRED Max. Wt. % | TYPICAL COMPOSITION Wt.% | TYPICAL COMPOSITION Vol.% | INGREDIENT STANDARDS ASTM | INGREDIENT STANDARDS Federal |
|---|---|---|---|---|---|---|
| PIGMENT: (5.5 ± 0.5 wt. %) | | | | | | |
| Carbon Black | 100 | — | 5.5 | 3.0 | D 561 | — |
| VEHICLE: (94.5 ± 0.5 wt. %) | | | | | | |
| Alkyd Resin Solids | 42 | — | 41.0 | 34.0 | — | TT-R-226, |
| Mineral Spirit Thinner | — | 58 | 53.5 | 63.0 | D 235 | TT-T-291, Type I |
| Driers | — | — | — | — | D 600, Class B | — |
| TOTALS | | | 100.0 | 100.0 | | |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1542** | Test Method for Qualitative Detection of Rosin in Varnishes |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 2371** | Test Method for Pigment Content of Solvent-Reducible Paints |
| **D 3278** | Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL STANDARDS:**

| | |
|---|---|
| **TT-R-266** | Resin, Alkyd: Solutions |
| **TT-T-291** | (Canceled) Thinner, Paint, Mineral Spirits, Regular and Odorless (Refer to A-A-2904) |

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 3011** | Condition in Container |
| **Method 3021** | Skinning (Partially Filled Container) |
| **Method 4021** | Pigment Content (Ordinary Centrifuge) |
| **Method 4053** | Nonvolatile Vehicle Content |
| **Method 4061** | Drying Time |
| **Method 4203** | Reducibility and Dilution Stability |
| **Method 4321** | Brushing Properties |
| **Method 4331** | Spraying Properties |
| **Method 4494** | Sag Test (Multinotch Blade) |
| **Method 4541** | Working Properties and Appearance of Dried Film |
| **Method 6221** | Flexibility |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals – Precautionary Labeling |

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1.

**4.2** The paint based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. No rosin or rosin derivatives may be used. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added.

**4.3** The paint shall conform to the composition (analysis) requirements of Table 2.

## 5. Properties

**5.1** The paint shall meet the requirements of Table 3 and Sections 5.2 through 5.9.

**5.2 ODOR:** The odor shall be normal for the materials permitted (ASTM D 1296).

**5.3 COLOR**: The color shall be typical of carbon black.

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when two volumes of the paint are slowly mixed with one volume of mineral spirits (FED-STD-141, Method 4203).

**5.5 WORKING PROPERTIES:** The paint shall be easily applied by all three methods when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging after drying.

**TABLE 2**
**ANALYSIS**

| | REQUIREMENTS | | | |
|---|---|---|---|---|
| **CHARACTERISTICS** | **Min. Wt. %** | **Max. Wt. %** | **ASTM** | **FED-STD-141** |
| Pigment | 5.0 | 6.0 | D 2371 | 4021 |
| Volatiles | — | 5.0 | D 2369 | — |
| Nonvolatile vehicle calculated by difference | 40.0 | — | — | 4053 |
| Uncombined water | — | 1.0 | D 1208 | — |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 0.5 | D 185 | — |
| Rosin or rosin derivatives | — | 0 | D 1542 | — |

Provided by : www.spic.ir Licensee: NISOC Library

**5.6 CONDITION IN CONTAINER:** The paint shall show no thickening, curdling, gelling, or hard caking when tested as specified in FED-STD-141, Method 3011, after storage for six months from date of delivery, in a full, tightly covered container, at a temperature of 50-110°F (10-43°C).

**5.7 SKINNING:** There shall be no skinning in a three-quarters filled closed container after 48 hours when tested in the standard manner specified in FED-STD-141, Method 3021.

**5.8 FLEXIBILITY:** The film prepared as described in FED-STD-141, Method 6221, after baking 24 hours at 200°F (93°C), shall show no cracking when suddenly chilled to 32°F (0°C) and quickly bent sharply on itself through 180° over a 1/8 inch (3 mm) mandrel. The film on the bent part of the panel shall show satisfactory adhesion.

**5.9 GLOSS:** The gloss shall be high (ASTM D 523).

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legible marked with the following information:

Name: Black Alkyd Paint
Specification: SSPC-Paint 102
Color: Black
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of Black Alkyd Paint

This paint is intended for use as an intermediate or finish coat over rust inhibitive primers on structural steel, over itself, or over other oleoresinous paints. All oil, grease, dust, and loose or nonadherent paint shall be removed, as residues of oil and grease remaining on the surface will result in decreased paint performance. If the undercoat is damaged, the steel shall be spot-cleaned and spot-primed with rust inhibitive primer.

Mix paint thoroughly before use. If the pigment has settled, pour off most of the liquid. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring contents to a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

Thin paint only if necessary, using only mineral spirits. For brush application under normal conditions, no thinning should be necessary. For spray applications add up to one pint of thinner per gallon of paint when necessary.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 1.5 mils (38 micrometers) dry or approximately 4 mils (102 micrometers) wet. The surface to be painted shall be dry; the surface temperature shall be at least 5°F (3°C) above the dew point, and the temperature of the air shall be over 40°F (4°C). Do not paint outdoors in rainy weather or if freezing temperatures are

**TABLE 3**
**PROPERTIES**

| | REQUIREMENTS | | | |
|---|---|---|---|---|
| CHARACTERISTICS | Min. Wt. % | Max. Wt. % | ASTM | FED-STD-141 |
| Viscosity* shear rate 200 rpm | | | | |
| Grams | 120 | 180 | D 562 | — |
| Krebs | 65 | 78 | D 562 | — |
| Weight per U.S. gallon, pounds | 7.6 (914 g/L) | — | D 1475 | — |
| Drying time, hours | | | | |
| Tack free | — | 10 | — | 4061 |
| Dry hard | — | 18 | — | 4061 |
| Flash point, degrees F | 100 (38°C) | — | D 3278 | — |
| Sag Resistance, mils | 6 (152 micrometers) | — | — | 4494 |

*Viscosity 48 hours or more after manufacture.

Provided by : www.spic.ir Licensee: NISOC Library

expected before the paint dries.

Allow paint at least 18 hours drying time in good weather before recoating.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed, or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 103

## Black Phenolic Paint

### 1. Scope

**1.1** This specification covers a quick drying black phenolic paint suitable as an intermediate or finish coat for steel. It has good weather resistance characteristics and good resistance to mild chemical exposure.

**1.2** This paint is suitable for exposures in Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), and is particularly suited for exposure in Environmental Zone 2A (frequently wet by fresh water), and is intended for brush or spray application over rust inhibitive priming paints, over itself, or over other oleoresinous paints.

**1.3** This paint is suitable as an intermediate or topcoat and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel." Oil paints shall be dried hard before coating with phenolic paints otherwise lifting, wrinkling, or checking may occur. This paint will dry in about 12 hours and should be recoated within 24 hours for optimum intercoat adhesion.

### 2. Description

**2.1** The fair weathering ability of this paint is the result of its phenolic varnish vehicle. Details of the composition are given in Table 1.

**2.2** This paint contains approximately 57% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 1.5 mils (38 micrometers) dry film thickness is 610 square feet/U.S. gallon (15.0 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARD:**

**PA 1** Shop, Field, and Maintenance Painting of Steel

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

**D 12** Specification for Raw Tung Oil
**D 154** Guide for Testing Varnishes
**D 185** Test Methods for Coarse Particles in Pigments, Pastes, and Paints
**D 235** Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
**D 331** Specification for 2-Ethoxyethanol
**D 561** Specification for Carbon Black Pigment for Paint
**D 562** Test Method for Consistency of Paints Using the Stormer Viscometer
**D 600** Specification for Liquid Paint Driers
**D 604** Specifications for Diatomaceous Silica Pigment
**D 801** Methods for Sampling and Testing Dipentene
**D 1208** Test Methods for Common Properties of Certain Pigments
**D 1210** Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems
**D 1296** Test Method for Odor of Volatile Solvents and Diluents
**D 1475** Test Method for Density of Paint, Varnish, Lacquer, and Related Products
**D 1542** Test Method for Qualitative Detection of Rosin in Varnishes
**D 1544** Test Method for Color of Transparent Liquids (Gardner Color Scale)
**D 1545** Test Method for Viscosity of Transparent Liquids by Bubble Time Method
**D 1642** Test Methods for Elasticity or Toughness of Varnishes
**D 2369** Test Method for Volatile Content of Coatings
**D 2371** Test Method for Pigment Content of Solvent-Reducible Paints
**D 3278** Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus
**D 3734** Specification for High-Flash Aromatic Naphthas
**D 3925** Practice for Sampling Liquid Paints and Related Pigmented Coatings

Provided by : www.spic.ir Licensee: NISOC Library

**3.6 FEDERAL STANDARDS:**

| | |
|---|---|
| **A-A-59106** | Ethylene Glycol Monoethyl Ether, Technical |
| **A-A-59107** | Toluene, Technical |
| **A-A-714** | Linseed Oil, Alkali Refined |
| **TT-N-97** | Naphtha: Aromatic |

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 2012** | Preparation of Tin Panels |
| **Method 3011** | Condition in Container |
| **Method 3021** | Skinning (Partially Filled Container) |
| **Method 4021** | Pigment Content (Ordinary Centrifuge) |
| **Method 4053** | Nonvolatile Vehicle Content |
| **Method 4061** | Drying Time |
| **Method 4203** | Reducibility and Dilution Stability |
| **Method 4321** | Brushing Properties |
| **Method 4331** | Spraying Properties |
| **Method 4494** | Sag Test (Multinotch Blade) |
| **Method 4541** | Working Properties and Appearance of Dried Film |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals —Precautionary Labeling |

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1.

**4.2** The paint based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. No rosin or rosin derivatives may be used. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added.

**4.3** The phenolic varnish portion of this paint shall conform to the composition requirements of Table 2.

**4.4** The paint shall conform to the composition (analysis) requirements of Table 3.

## 5. Properties

**5.1** The phenolic varnish portion of this paint shall meet the requirements of Table 4 and Sections 5.2 through 5.8.

**5.2 ODOR:** The odor shall be normal for the materials permitted (ASTM D 1296).

**5.3 COLOR:** The color shall be 10 to 12 (ASTM D 1544).

**5.4 ELASTICITY:** Elasticity shall be 130% using the run kauri method (ASTM D 1642).

**5.5 REACTIVITY:** The phenolic varnish shall be nonreactive (ASTM D 154).

**5.6 SKINNING:** There shall be no skinning in a three-quarters filled closed container after 48 hours when tested in the standard manner specified in FED-STD-141, Method 3021.

**5.7 WATER RESISTANCE:** Tin panels prepared in accordance with FED-STD-141, Method 2012 shall be dipped in the phenolic varnish, drained, and allowed to dry 72 hours prior to immersion. Immersion shall be in distilled water at

**TABLE 1**
**COMPOSITION OF THE PAINT**

| | REQUIRED | | TYPICAL COMPOSITION | | INGREDIENT STANDARDS | |
|---|---|---|---|---|---|---|
| INGREDIENTS | Min. Wt. % | Max. Wt. % | Wt.% | Vol.% | ASTM | Federal |
| PIGMENT: (12.5 ± 1 wt. %) | | | | | | |
| Carbon Black | 39 | — | 5.0 | 3.0 | D 561 | — |
| Diatomaceous Silica | — | 61 | 7.5 | 3.8 | D 604 | |
| VEHICLE: (87.5 ± 1 wt. %) | | | | | | |
| Phenolic Varnish | 82.9 | — | 72.4 | 75.3 | — | |
| Mineral Spirit Thinner | — | 16.5 | 14.4 | 17.4 | D 235 | — |
| Driers | — | 0.6 | 0.7 | 0.5 | D 600, Class B | — |
| TOTALS | | | 100.0 | 100.0 | | |

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**COMPOSITION OF THE PHENOLIC VARNISH***

| INGREDIENTS | REQUIRED Min. Wt.% | REQUIRED Max. Wt. % | TYPICAL COMPOSITION Lbs. | (kg) | Gals. | (L) | INGREDIENT STANDARDS ASTM | FEDERAL |
|---|---|---|---|---|---|---|---|---|
| Unmodified Para Phenyl Phenol-formaldehyde Resin | 16.7 | — | 100.0 | (45.4) | 10.0 | (37.8) | — | — |
| Linseed Oil (Alkali Refined) | 17.1 | — | 103.0 | (46.7) | 13.0 | (49.2) | — | A-A-714 |
| Tung Oil | 26.0 | — | 156.6 | (70.8) | 20.0 | (75.7) | D 12 | |
| — | | | | | | | | |
| Mineral Spirit Thinner | — | 28.1 | 169.0 | (76.7) | 26.0 | (98.4) | D 235 | TT-T-291, Type I |
| Dipentene | — | 4.7 | 28.3 | (12.8) | 4.0 | (15.1) | D 801 | — |
| Ethylene Glycol Monoethyl Ether | — | 3.8 | 23.4 | (10.6) | 3.0 | (11.4) | D 331 | A-A-59106 |
| Toluene | — | 2.4 | 14.5 | (6.6) | 2.0 | (7.6) | — | A-A-59107 |
| Naphtha (Aromatic) | — | 1.2 | 7.2 | (3.3) | 1.0 | (3.8) | D 3734 | TT-N-97 |
| TOTAL | 100.0 | | | | | | | |

* The following cooking procedure is intended as a guide only. Heat the resin and the linseed oil to 550°F (288°C) in 50 to 60 minutes. Add the tung oil and reheat to 465°F (241°C) in 15 to 20 minutes. Pull from fire and allow to cool to 420°F (216°C) and thin; add the thinners in the order shown. The finished varnish should be filtered or centrifuged to remove all visible foreign solid materal.

**TABLE 3**
**ANALYSIS OF THE PAINT**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | REQUIREMENTS Max. Wt.% | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Pigment | 11.5 | — | D 2371 | 4021 |
| Volatiles | — | 37.0 | D 2369 | — |
| Nonvolatile vehicle calculated by difference | 51 | — | — | 4053 |
| Uncombined water | — | 1.0 | D 1208 | — |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 1.0 | D 185 | — |
| Rosin or rosin derivatives | — | 0 | D 1542 | |

212°F (100°C) for seven hours for the hot water test and at 68 °F (20°C) for 96 hours for the cold water test. The panels during immersion shall be in a vertical position. A recovery period of two hours shall be allowed before examination of the panel under test. Acceptable specimens shall show no whitening, dulling, or blistering.

**5.8 ALKALI RESISTANCE:** Dip the closed end of a well-cleaned 1 by 6 inch (2.5 by 15 cm) test tube to a depth of 4 inches (10 cm) into the phenolic varnish and allow to dry for 72 hours with the mouth of the test tube down. Dip the closed end of the test tube to a depth of 2 inches (5 cm) below the surface of a 5% caustic soda (NaOH) solution at 68°F (20°C) for five hours. After removal, immediately rinse under gently running water being careful not to touch the treated film. Dry for two hours and examine under suitable light. Acceptable specimens shall show no visible dulling, checking, or blistering. Defects at the extreme bottom of the test tube shall be disregarded.

**5.9** The paint shall meet the requirements of Table 5 and Sections 5.10 through 5.15.

**5.10 ODOR:** The odor shall be normal for the materials permitted (ASTM D 1296).

Provided by : www.spic.ir Licensee: NISOC Library

**5.11 COLOR:** The color of the mixed paint shall be typical of carbon black.

**5.12 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the mixed paint when two volumes of the paint are slowly mixed with one volume of mineral spirits (FED-STD-141, Method 4203).

**5.13 WORKING PROPERTIES:** The mixed paint shall be easily applied by all three methods when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging after drying.

**5.14 CONDITION IN CONTAINER:** The mixed paint shall show no thickening, curdling, gelling, or hard caking when tested as specified in FED-STD141, Method 3011, after storage for six months from date of delivery, in a full, tightly covered container, at a temperature of 50-110°F (10-43°C).

**5.15 SKINNING:** There shall be no skinning in a three-quarters filled closed container after 48 hours when tested in the standard manner specified in FED-STD-141, Method 3021.

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legible marked with the following information:

Name: Black Phenolic Paint
Specificaton: SSPC-Paint 103
Color: Black
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions use shall be supplied with each container of paint:

Directions for Use of Black Phenolic Paint

This paint is intended for use as an intermediate or finish coat over rust inhibitive primers on structural steel, over itself, or over other oleoresinous paints. All oil, grease, dust, and loose or nonadherent paint shall be removed, as residues of oil and greases remaining on the surface will result in decreased paint performance. If the undercoat is damaged, the steel shall be spot-cleaned and spot-primed with rust inhibitive primer.

Mix paint thoroughly before use. If the pigment has settled, pour off most of the liquid. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring contents to a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

Thin paint only if necessary, using only mineral spirits. For brush application under normal conditions, no thinning should be necessary. For spray applications add up to one pint of thinner per gallon of paint when necessary.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 1.5 mils (38 micrometers) dry or approximately 3 mils (76 micrometers) wet. The surface to be painted shall be dry; the surface temperature shall be at least 5°F (3°C) above the dew point, and the temperature of the air shall be over 40°F (4°C). Do not paint outdoors in rainy weather or if freezing temperatures are

**TABLE 4**
**PROPERTIES OF THE PHENOLIC VARNISH**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | METHOD | FED-STD-141 |
|---|---|---|---|---|
| Viscosity* (Gardner-Holdt) | C-D | — | D 1545 | — |
| Weight per U.S. gallon, pounds | 7.7 (926 g/L) | — | D 1475 | — |
| Nonvolatile | 59 | 61 | — | 4053 |
| Drying time, hours | | | | |
| Tack free | 1 | 4 | — | 4061 |
| Dry hard | — | 12 | — | 4061 |

*Viscosity 48 hours or more after manufacture.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 5**
**PROPERTIES**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Viscosity* shear rate 200 rpm | | | | |
| Grams | 120 | 250 | D 562 | — |
| Krebs | 65 | 90 | D 562 | — |
| Weight per U.S. gallon, pounds | 8.75 (1.05 kg/L) | — | D 1475 | — |
| Fineness of grind, Hegman units | 4 | — | D 1210 | — |
| Drying time, hours | | | | |
| Tack free | 1 | 4 | — | 4061 |
| Dry hard | 6 | 12 | — | 4061 |
| Flash point, degrees F | 86 (30°C) | — | D 3278 | — |
| Sag Resistance, mils | 4 (102 micrometers) | — | — | 4494 |

*Viscosity 48 hours or more after manufacture.

expected before the paint dries.

This paint is fast drying and will dry hard in about 12 hours; special care must be exercised to prevent this paint from drying too hard before additional coats are applied otherwise special precautions must be taken to ensure adhesion of these coats. Recoating within 24 hours if recommended for maximum intercoat adhesion.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 104
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# Paint Specification No. 104

## White or Tinted Alkyd Paint

### 1. Scope

**1.1** This specification covers a white or tinted low gloss alkyd paint for steel. It has good weathering in rural, industrial, and marine atmospheres. It is also an excellent general purpose paint for use in interior locations.

**1.2** This paint is suitable for exposures in Environmental Zones 1A (interior, normally dry) and 1B (exterior, normally dry) and is intended for brush or spray application over rust inhibitive priming paints, over itself, or over other oleoresinous paints. This paint is suitable as an intermediate or topcoat and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**1.3** Four types are available under this specification. Type I covers White Paint; Type II covers Medium to Light Gray to Tan Paint; Type III covers Light Green Paint; and Type IV covers a Dark or Forest Green Paint. The shades are variable and are to be agreed upon between the purchaser and the supplier.

### 2. Description

**2.1** The good weathering ability of this paint is the result of its alkyd vehicle. Details of the composition are given in Table 1.

**2.2** This primer contains approximately 48% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 1.5 mil (38 micrometers) dry film thickness is 510 square feet/U.S. gallon (12.6 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

3.1 The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

**TABLE 1**
**COMPOSITION**

| | TYPICAL COMPOSITION | | | | INGREDIENT STANDARDS | |
|---|---|---|---|---|---|---|
| INGREDIENTS | Type I | Type II | Type III | Type IV | ASTM | FEDERAL |
| PIGMENT: (± 2.5 wt. %) | (47.5) | (42.4) | (44.8) | (21.5) | — | — |
| Titanium Dioxide (Min.) | 67.0 | 30.0 | 30.0 | — | D 476 | — |
| Reinforcing and Tinting Pigments (Max.) | 33.0 | 70.0 | 70.0 | 10.0 | D 602<br>D 605 | —<br>— |
| Chrome Green | — | — | — | 90.0 | D 212 | |
| TOTALS | 100.0 | 100.0 | 100.0 | 100.0 | | |
| VEHICLE: (± 2.5 wt. %) | (52.5) | (57.6) | (55.2) | (78.5) | | |
| Alkyd Resin Solids | 46.8 | 50.1 | 50.9 | 56.0 | — | TT-R-266 |
| Mineral Spirit Thinner | 53.2 | 49.9 | 49.1 | 44.0 | D 235 | — |
| Driers | — | — | — | — | D 600, Class B | — |
| TOTALS | 100.0 | 100.0 | 100.0 | 100.0 | | |

Provided by : www.spic.ir Licensee: NISOC Library

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

**3.4 SSPC STANDARD:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 185** | Test Methods for Coarse Particles in Pigments, Pastes, and Paints |
| **D 212** | (Canceled) Specification for Chrome Green Pigment |
| **D 235** | Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent) |
| **D 476** | Specification for Titanium Dioxide Pigments |
| **D 523** | Test Method for Specular Gloss |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 600** | Specification for Liquid Paint Driers |
| **D 602** | Specification for Barium Sulfate Pigments |
| **D 605** | Specification for Magnesium Silicate Pigment (Talc) |
| **D 1208** | Test Methods for Common Properties of Certain Pigments |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1542** | Test Method for Qualitative Detection of Rosin in Varnishes |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 2371** | Test Method for Pigment Content of Solvent-Reducible Paints |
| **D 3278** | Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL STANDARDS:**

| | |
|---|---|
| **TT-E-489** | Enamel, Alkyd, Gloss (Low VOC Content) |
| **TT-R-266** | Resin, Alkyd: Solutions |

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 3011** | Condition in Container |
| **Method 3021** | Skinning (Partially Filled Container) |
| **Method 4021** | Pigment Content (Ordinary Centrifuge) |
| **Method 4053** | Nonvolatile Vehicle Content |
| **Method 4061** | Drying Time |
| **Method 4203** | Reducibility and Dilution Stability |
| **Method 4321** | Brushing Properties |
| **Method 4331** | Spraying Properties |
| **Method 4494** | Sag Test (Multinotch Blade) |
| **Method 4541** | Working Properties and Appearance of Dried Film |
| **Method 6221** | Flexibility |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals—Precautionary Labeling |

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1 above.

**4.2** The paint based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. No rosin or rosin derivatives may be used. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added.

**4.3** The paint shall conform to the composition (analysis) requirements of Table 2.

## 5. Properties

**5.1** The paint shall meet the requirements of Table 3 Sections 5.2 through 5.10.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**5.3 COLOR:** The color shall be agreed upon by the parties concerned.

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when two volumes of the paint are slowly mixed with one volume of mineral spirits (FED-STD-141, Method 4203).

**5.5 WORKING PROPERTIES:** The paint shall be easily applied by all three methods when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**ANALYSIS**

| CHARACTERISTICS | REQUIREMENTS Type I | Type II | Type III | Type IV | ASTM | FED-STD-141 |
|---|---|---|---|---|---|---|
| Pigment (Min.) | 45.0 | 39.9 | 42.3 | 19.0 | D 2371 | 4021 |
| Volatiles (Max.) | 30.0 | 30.0 | 29.0 | 36.0 | D 2369 | — |
| Nonvolatile vehicle (Min.) calculated by difference | 23.5 | 27.5 | 26.5 | 42.5 | — | 4053 |
| Uncombined water (Max.) | 1.0 | 1.0 | 1.0 | 1.0 | D 1208 | — |
| Coarse particles and skins, as retained onstandard 325 mesh screen (Max.) | 1.0 | 1.0 | 1.0 | 1.0 | D 185 | — |
| Rosin or rosin derivatives | 0 | 0 | 0 | 0 | D 1541 | — |

**TABLE 3**
**PROPERTIES**

| CHARACTERISTICS | REQUIREMENTS Type I | Type II | Type III | Type IV | ASTM | FED-STD-141 |
|---|---|---|---|---|---|---|
| Viscosity* shear rate 200 rpm | | | | | | |
| Kreb units (Min.) | 65 | 65 | 65 | 65 | D 562 | — |
| Kreb units (Max.) | 85 | 85 | 85 | 85 | D 562 | — |
| Weight per U.S. gallon, pounds (Min.) | 11.2 (1.35 kg/L) | 10.7 (1.29 kg/L) | 11.2 (1.35 kg/L) | 9.0 (1.08 kg/L) | D 1475 | — |
| Fineness of grind, Hegman units | 6 | 6 | 6 | 6 | D 1210 | — |
| Drying time, hours Dry hard (Max.) | 18 | 18 | 18 | 18 | — | 4061 |
| Flash point, °F (Min.) | 86 (30°C) | 86 (30°C) | 86 (30°C) | 86 (30°C) | D 3278 | — |
| Sag Resistance, mils (Min.)** | 6 | 6 | 6 | 6 | | 4494 |

*Viscosity 48 hours or more after manufacture.
**6 mils = 150 micrometers

paint shall show no streaking, running, or sagging after drying.

**5.6 CONDITION IN CONTAINER:** The paint shall show no thickening, curdling, gelling, or hard caking when tested as specified in FED-STD-41, Method 3011, after storage for six months from date of delivery, in a full, tightly covered container, at a temperature of 50-110°F (10-43°C).

**5.7 SKINNING:** There shall be no skinning in a three-quarters filled closed container after 48 hours when tested in the standard manner specified in FED-STD-141, Method 3021.

**5.8 FLEXIBILITY:** The film prepared as described in FED-STD-141, Method 6221, after baking 24 hours at 200°F (93°C), shall show no cracking when suddenly chilled to 32°F (0°C) and quickly bent sharply on itself through 180° over a 1/8 inch (3 mm) mandrel. The film on the bent part of the panel shall show satisfactory adhesion.

**5.9 GLOSS:** The gloss shall be no lower than eggshell

Provided by : www.spic.ir Licensee: NISOC Library

(ASTM D 523).

**5.10 TINTING PIGMENTS:** Tinting pigments shall be permanent colors and comply with provisions of Federal Specification TT-E-489 for the color specified.

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legibly marked with the following information:

Name: White or Tinted Alkyd Paint
Specification: SSPC-Paint 104
Color: White (or Tinted)
Lot Number:
Stock Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions of use shall be supplied with each container of paint:

Directions for Use of White or Tinted Alkyd Paint

This paint is intended for use as an intermediate or finish coat over rust inhibitive primers on structural steel, over itself, or over other oleoresinous paints. All oil, grease, dust, and loose or nonadherent paint shall be removed, as residues of oil and grease remaining on the surface will result in decreased paint performance. If the undercoat is damaged, the steel shall be spot-cleaned and spot-primed with rust inhibitive primer.

Mix paint thoroughly before use. If the pigment has settled, pour off most of the liquid. Thoroughly mix the pigment with the remaining liquid, taking care to scrape all the pigment off the bottom of the can. Gradually add the poured-off liquid and mix thoroughly. Mixing may be made easier by transferring contents to a larger container or by pouring the paint to and from another container. Examine bottom of container for unmixed pigment. Screen paint before applying.

Thin paint only if necessary, using only mineral spirits. For brush application under normal conditions, no thinning should be necessary. For spray applications, add up to one pint of thinner per gallon (120 ml/L) of paint when necessary.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 1.5 mils (38 micrometers) dry or approximately 3.0 mils (76 micrometers) wet. The surface to be painted shall be dry; the surface temperature shall be at least 5°F (3°C) above the dew point; and the temperature of the air shall be over 40°F (4°C). Do not paint outdoors in rainy weather or if freezing temperatures are expected before the paint dries.

Allow paint at least 18 hours drying time in good weather before recoating.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 106
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 106

## Black Vinyl Paint

### 1. Scope

**1.1** This specification covers a ready-to-mix black vinyl chloride-acetate paint intended for use over vinyl butyral wash primer (SSPC-Paint 27*) or as an intermediate or finish coat over vinyl paint. This paint is not intended for use over bare steel.

**1.2** This paint is suitable for exposures in Environmental Zones 2C (fresh water immersion), 2D (salt water immersion), 3A (chemical, acidic), and 3B (chemical, neutral), and is intended primarily to be used in a system applied to blast cleaned (SSPC-SP 10) or pickled (SSPC-SP 8) steel. When used for salt water immersion, a wash primer is recommended. Because of the possibility of lifting of the undercoats, this paint is not intended to be used over types of paints which have poor solvent resistance. This paint is intended primarily for application by conventional air spray and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

### 2. Description

**2.1** This paint consists of carbon black pigment and vinyl resins in solution suitably plasticized to make a durable, elastic paint film. This paint includes a hydroxyl-containing polymer for good adhesion to wash primers or other vinyl paints. Adhesion to bare steel is poor. Details of the composition are given in Table 1.

**2.2** This paint contains approximately 13% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 1.0 mil (25 micrometers) dry film thickness is 210 square feet/U.S. gallon (5.1 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

**TABLE 1**
**COMPOSITION**

| INGREDIENTS | REQUIRED Min. Wt. % | REQUIRED Max. Wt. % | TYPICAL COMPOSITION Wt.% | TYPICAL COMPOSITION Vol.% | INGREDIENT STANDARDS ASTM |
|---|---|---|---|---|---|
| PIGMENT: (1.0-1.5 %) | | | | | |
| Carbon Black | 100 | — | 1.0 | 0.5 | D 561 |
| VEHICLE: (98.5-99.0 %) | | | | | |
| Vinyl Resin A[1] | 7.6 | — | 7.5 | 4.8 | — |
| Vinyl Resin C[2] | 7.6 | — | 7.5 | 4.8 | — |
| Dioctyl Phthalate[3] | 3.0 | — | 3.0 | 2.7 | — |
| Methyl Isobutyl Ketone[4] | — | 40.9 | 40.5 | 45.4 | D 1153 |
| Toluene | — | 40.9 | 40.5 | 41.8 | D 362 |
| TOTALS | | | 100.0 | 100.0 | |

1 Vinyl Resin A shall be a hydroxyl containing vinyl chloride-acetate copolymer. It shall contain 89.5% to 91.5% vinyl chloride, 5.3% to 7.0% vinyl alcohol, and 2.0% to 5.5% vinyl acetate. The inherent viscosity of the resin (ASTM D 1243, Method A) at 20°C shall not be less than 0.5.

2 Vinyl Resin C shall be a vinyl chloride-acetate copolymer. It shall contain 85% to 88% vinyl chloride, 12% to 15% vinyl acetate, by weight. The inherent viscosity of the resin (ASTM D 1243, Method A) at 20°C shall not be less than 0.48.

3 Dioctyl phthalate (di-2-ethylhexyl phthalate) shall be commercial material which conforms to the following requirements:
Specific gravity @ 25°C 0.980—0.9861
Refractive index @ 25°C 1.4830—1.6859

4 When specified in the procurement documents, suitable high boiling vinyl solvent may be substituted for a portion of the methly isobutyl ketone to make the paint more amenable to application in hot weather or by brush.

Provided by : www.spic.ir Licensee: NISOC Library

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

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

**3.4 SSPC STANDARDS AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **Paint 27*** | Basic Zinc Chromate – Vinyl Butyral Wash Primer |
| **SP 8** | Pickling |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 185** | Test Methods for Coarse Particles in Pigments, Pastes, and Paints |
| **D 362** | (Canceled) Specification for Industrial Grade Toluene |
| **D 561** | Specification for Carbon Black Pigment for Paint |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 1153** | Specification for Methyl Isobutyl Ketone |
| **D 1208** | Test Methods for Common Properties of Certain Pigments |
| **D 1210** | Test Methods for Fineness of Dispersion of Pigment-Vehicle Systems |
| **D 1243** | Test Method for Dilute Solution Viscosity of Vinyl Chloride Polymers |
| **D 1296** | Test Method for Odor of Volatile Solvents and Diluents |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1640** | Test Methods for Dryng, Curing, or Film Formation of Organic Coatings at Room Temperature |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL STANDARDS:**

| | |
|---|---|
| **DoD-P-15328*** | Primer (Wash), Pretreatment (Formula No. 117 for Metals) |

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 3011** | Condition in Container |
| **Method 4021** | Pigment Content (Ordinary Centrifuge) |
| **Method 4053** | Nonvolatile Vehicle Content |
| **Method 4061** | Drying Time |
| **Method 4092** | Coarse Particles and Skins in Synthetic Vehicle Enamels, Lacquers and Dopes |
| **Method 4203** | Reducibility and Dilution Stability |
| **Method 4331** | Spraying Properties |
| **Method 4541** | Working Properties and Appearance of Dried Film |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals —Precautionary Labeling |

**TABLE 2**
**ANALYSIS**

| | REQUIREMENTS | | | |
|---|---|---|---|---|
| **CHARACTERISTICS** | **Min. Wt. %** | **Max. Wt. %** | **ASTM** | **FED-STD-141** |
| Pigment | 1.0 | 1.5 | D 1208 | 4021† |
| Volatiles | 78.0 | 81.0 | D 2369 | — |
| Nonvolatile vehicle calculated by difference | 18.0 | 20.5 | — | 4053 |
| Uncombined water | — | 0.5 | D 1208 | — |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 0.25 | D 185 | 4092 |

† Using extraction mixture “C” (1:1 toluene and acetone)

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 3**
**PROPERTIES**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Viscosity† shear rate 200 rpm | | | | |
| Grams | 100 | 150 | D 562 | — |
| Kreb units | 60 | 72 | D 562 | — |
| Weight per U.S. gallon, pounds | 7.4 (890 g/L) | 8.0 (962 g/L) | D 1475 | — |
| Fineness of grind, Hegman units | 7 | — | D 1210 | — |
| Drying time, minutes | | | | |
| Tack free | — | 15 | D 1640 | 4061 |
| Dry hard | — | 30 | D 1640 | 4061 |

†Viscosity 48 hours after manufacture.

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1.

**4.2** The paint based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added.

**4.3** The paint shall conform to the composition (analysis) requirements of Table 2.

## 5. Properties

**5.1** The paint shall meet the requirements of Table 3 and Sections 5.2 through 5.7.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**5.3 COLOR:** The color shall be black.

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when two volumes of the paint are slowly mixed with one volume of thinner consisting of 85% toluene and 15% methyl isobutyl ketone by volume (FED-STD-141, Method 4203).

**5.5 ADHESION:** The paint under test shall show good adhesion when tested as follows: apply one coat (1.0 mils, 25 micrometers dry film thickness) of the mixed paint to a panel pretreated with wash primer MIL-P-15328, "Primer (Wash) Pretreatment," or SSPC-Paint 27, "Basic Zinc Chromate-Vinyl Butyral Wash Primer" (0.5 mils, 12.5 micrometers dry film thickness). After a 24-hour dry, the film under test on each panel shall be subjected to a knife test to determine whether the paint exhibits good adhesion to the undercoats.

**5.6 WORKING PROPERTIES:** The paint shall be easily applied when tested in accordance with FED-STD-141, Methods 4331 and 4541. The paint shall show no streaking, running, or sagging after drying.

**5.7 CONDITION IN CONTAINER:** The paint shall show no thickening, curdling, gelling, or hard caking when tested as specified in Federal Standard No. 141, Method 3011, after storage for six months from date of delivery, in a full, tightly covered container, at a temperature of 50-110°F (10-43°C).

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legible marked with the following information:

Name: Black Vinyl Paint
Specification: SSPC-Paint 106
Color: Black
Lot Number:
Stock Number:
Date of Manufacturer:
Quantity of Paint in Container:
Information and Warnings as may be required be Federal and State Laws:
Manufacturer's Name and Address:

Provided by : www.spic.ir Licensee: NISOC Library

**6.3 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use of Black Vinyl Paint

This paint is intended for use as an intermediate or finish coat over vinyl butyral wash primer (SSPC-Paint 27) or vinyl resin paint. Mix thoroughly before use.

The paint shall be thinned as necessary with solvent containing not more than 85% toluene and 15% methyl isobutyl ketone or methyl ethyl ketone. The amount of thinning will depend upon application methods and conditions, and may be as high as 25% to 33% by volume of the paint.

Apply by conventional air spray. Brushing may be used in small areas. The surface to be painted shall be dry and above 35°F (2°C), not less than 5°F (3°C) above the dew point. Do not paint outdoors in rainy weather. Apply so as to obtain a minimum dry film thickness of 1.0 mils (25 micrometers).

A wet film of paint shall be deposited on the surface when spraying; the spray gun should be adjusted so that proper atomization is obtained but no dry powder is deposited on the surface; the nozzle should be held about six inches from the surface during application.

If application is to be made by brush, apply with a brush heavily loaded with paint; apply quickly and smoothly; avoid excessive brushing and do not go back over the surface until thoroughly dry.

At temperatures between 60 and 80°F (16 and 27°C), dry at least one hour between coats and 72 hours before immersion. Varying atmospheric conditions and degrees of ventilation in confined spaces may allow shorter or require longer drying times.

This paint is not to be used as a priming coat next to bare steel.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established inthe procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

*This paint contains chromate pigments. Users are urged to follow all health. safety, and environmental requirements in applying, handling, and disposing of these materials.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Paint 108
November 1, 1982
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT SPECIFICATION NO. 108

## High-Build Thixotropic Leafing Aluminum Paint

### 1. Scope

**1.1** This specification covers a high-build thixotropic leafing aluminum paint primarily intended for the topcoat in a two-coat high-build system, with a thixotropic rust inhibitive primer, or as a one-coat high-build repaint over spot priming.

**1.2** This paint is suitable for exposures in Environmental Zones 1A (interior, normally dry) and 1B (exterior, normally dry) and is intended for brush or spray application over rust inhibitive priming paints, over itself, or over other oleoresinous paints. This paint is suitable as a topcoat and is to be applied in accordance with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

### 2. Description

**2.1** High-build thixotropic aluminum paint contains leafing aluminum pigment and a thixotropic long oil alkyd in a single package. Thixotropic paint appears to possess a high viscosity, which is altered because of a reversible gel structure when the paint is agitated. When the paint is stirred, sprayed, brushed, or rolled, the level of viscosity falls rapidly and the paint becomes liquefied. During application, the appearance is similar to other coatings. However, the liquid state will not remain for long. If undisturbed, the paint will re-gel within a short time. Details of the composition are given in Table 1.

**2.2** This paint contains approximately 49% by volume of nonvolatile film-forming solids (pigment and binder). The theoretical spreading rate for a 3.0 mil (76 micrometers) dry film thickness is 260 square feet/U.S. gallon (6.4 square meters/liter). Actual spreading rates can be significantly lower.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC STANDARDS:**

**PA 1** Shop, Field, and Maintenance Painting of Steel

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

**TABLE 1**
**COMPOSITION OF PAINT**

| INGREDIENTS | REQUIREMENTS Min. Wt. % | REQUIREMENTS Max. Wt. % | INGREDIENT STANDARDS ASTM | INGREDIENT STANDARDS FEDERAL |
|---|---|---|---|---|
| PIGMENT: (26.2% min.) | | | | |
| Aluminum Paste, 65% non-volatile | 100 | — | D 962, Type 2 Class B Class 2 | — |
| VEHICLE: (73.8% max.) | | | | |
| Thixotropic Alkyd Solids[1] | 55.6 | — | — | — |
| Mineral Spirit Thinner | — | 44.5 | D 235 | — |
| Driers | — | — | D 600, Class B | — |
| Additives | — | — | — | — |

[1] See Table 2 for analysis of the thixotropic alkyd resin.

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **D 185** | Test Methods for Coarse Particles in Pigments, Pastes, and Paints |
| **D 235** | Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent) |
| **D 562** | Test Method for Consistency of Paints Using the Stormer Viscometer |
| **D 600** | Specification for Liquid Paint Driers |
| **D 962** | Specification for Aluminum Powder and Paste Pigments for Paints |
| **D 1208** | Test Methods for Common Properties of Certain Pigments |
| **D 1398** | Test Method for Fatty Acid Content of Alkyd Resins and Alkyd Resin Solutions |
| **D 1475** | Test Method for Density of Paint, Varnish, Lacquer, and Related Products |
| **D 1542** | Test Method for Qualitative Detection of Rosin in Varnishes |
| **D 1544** | Test Method for Color of Transparent Liquids (Gardner Color Scale) |
| **D 1639** | Test Method for Acid Value of Organic Coating Materials |
| **D 1640** | Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature |
| **D 2369** | Test Method for Volatile Content of Coatings |
| **D 3278** | Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus |
| **D 3925** | Practice for Sampling Liquid Paints and Related Pigmented Coatings |

**3.6 FEDERAL STANDARDS:**

**FED-STD-141** Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

| | |
|---|---|
| **Method 3011** | Condition in Container |
| **Method 3021** | Skinning (Partially Filled Container) |
| **Method 4021** | Pigment Content (Ordinary Centrifuge) |
| **Method 4053** | Nonvolatile Vehicle Content |
| **Method 4061** | Drying Time |
| **Method 4203** | Reducibility and Dilution Stability |
| **Method 4321** | Brushing Properties |
| **Method 4331** | Spraying Properties |
| **Method 4494** | Sag Test (Multinotch Blade) |
| **Method 4541** | Working Properties and Appearance of Dried Film |

**3.7 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:**

| | |
|---|---|
| **Z129.1** | Hazardous Industrial Chemicals—Precautionary Labeling |

## 4. Composition

**4.1** Ingredients and proportions shall be as specified in Table 1.

**4.2** The paint based on the specified ingredients shall be uniform, stable in storage, and free from grit and coarse particles. No rosin or rosin derivatives may be used. Beneficial additives such as anti-skinning agents, suspending agents, or wetting aids may be added. Leafing aids or stabilizers are also permitted if they do not substantially alter the thixotropy of film properties.

**4.3** The thixotropic alkyd resin shall conform to the composition (analysis) requirements of Table 2.

**4.4** The paint shall conform to the composition (analysis) requirements of Table 3.

## 5. Properties

**5.1** The paint shall meet the requirements of Table 4 and Sections 5.2 through 5.8.

**5.2 ODOR:** Shall be normal for the materials permitted (ASTM D 1296).

**5.3 COLOR:** A dried film of the paint shall show good leafing as indicated by a bright aluminum surface.

**5.4 COMPATIBILITY:** There shall be no evidence of incompatibility of any of the ingredients of the paint when two volumes of the paint are slowly mixed with one volume of mineral spirits (FED-STD-141, Method 4203).

**5.5 WORKING PROPERTIES:** The paint shall be easily applied by all three methods when tested in accordance with FED-STD-141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging after drying.

**5.6 CONDITION IN CONTAINER:** The paint shall show no thickening, gas evolution, curdling, gelling, or hard caking when tested as specified in FED-STD 141, Method 3011, after storage for 12 months from date of delivery, in a full, tightly covered container, at a temperature of 50-110°F (10-43°C).

**5.7 SKINNING:** There shall be no skinning in a three-quarters filled closed container after 48 hours when tested in the standard manner specified in FED-STD-141, Method 3021.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 2**
**ANALYSIS OF THIXOTROPIC ALKYD RESIN**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | Max. Wt.% | ASTM |
|---|---|---|---|
| Nonvolatile resin, % by weight of solution | 59 | 61 | D 1208 |
| Drying oil acids, % by weight of solution | 65 | — | D 1398 |
| Phthalic anhydride, % by weight of nonvolatile resin | 9 | — | D 1306 |
| Acid number of nonvolatile resin | — | 8 | D 1639 |
| Color, Gardner color standards of 1953 | — | 13 | D 1544 |
| Polyamide resin, % by weight of nonvolatile resin[1] | 2.5 | — | — |
| Rosin or rosin derivatives | — | 0 | D 1542 |

[1] Polyamide Resin:
Softening point—220-240°F (105—115°C)
Amine value—2-7
Acid number—10 maximum
Specific graviy—0.95-0.98

**TABLE 3**
**ANALYSIS OF PAINT**

| CHARACTERISTICS | REQUIREMENTS Min. Wt. % | Max. Wt.% | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Pigment | 17 | — | D 1208 | 4021 |
| Volatiles | — | 42 | D 2369 | — |
| Nonvolatile vehicle calculated by difference | 41 | — | — | 4053 |
| Uncombined water | — | 1.0 | D 1208 | — |
| Coarse particles and skins, as retained on standard 325 mesh screen | — | 0.5 | D 185 | — |
| Rosin or rosin derivatives | — | 0 | D 1542 | — |

**5.8 FLEXIBILITY:** Apply paint with a 1-1 /2" (4 cm) brush to a 4" x 12" (10 cm x 30 cm) 0.032" (0.8 cm) thick cold-rolled steel panel with the panel horizontal. Apply paint quickly obtaining a wet film thickness of 7-10 mils (178- 204 micrometers) on as much of the panel as possible. Final brush stroke shall be in the 12" (30 cm) direction, air dried for 72 hours at 70-75°F (21-24°C), and baked five hours at 210°F (99°C). This panel shall show no cracking on the radius of the bend when bent over a 1-1/4" (3.2 cm) mandrel. The film on the bent part shall show satisfactory adhesion.

## 6. Labeling

**6.1** Refer to ANSI Z129.1, "Hazardous Industrial Chemicals—Precautionary Labeling." Other guidelines can be found in the National Paint and Coating Association (NPCA) "Paint Industry Labeling Guide."

**6.2 MARKING OF CONTAINERS:** Each container shall be legible marked with the following information:

Name: High-Build Thixotropic Leafing Aluminum Paint
Specification: SSPC-Paint 108
Color:
Aluminum Lot Number:
Date of Manufacture:
Quantity of Paint in Container:
Information and Warnings as may be required by Federal and State Laws:
Manufacturer's Name and Address:

**6.3 DIRECTIONS FOR USE:** The following directions for use shall be supplied with each container of paint:

Directions for Use Thixotropic Aluminum Paint

This paint is intended for use as a finish coat over rust inhibitive primers on structural steel, over itself, or over other oleoresinous paints. It is suitable for outdoor exposure in rural, industrial, and marine environments and for interior use. All oil, grease, dust and loose or nonadherent paint shall be removed; oil and grease shall be removed to the fullest extent practical, as residues of oil and grease remaining on the surface will result in decreased paint performance. If the undercoat is damaged,

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 4**
**PROPERTIES OF PAINT**

| CHARACTERISTICS | REQUIREMENTS Min. | Max. | ASTM | FED-STD-141 |
|---|---|---|---|---|
| Viscosity† | | | | |
| Krebs units | 90 | 95 | D 562 | — |
| Weight per U.S. gallon, pounds | 8.4 (1.01 kg/L) | 8.7 (1.05 kg/L) | D 1475 | — |
| Drying time, hours | | | | |
| Set to touch | — | 4 | D 1640 | 4061 |
| Tack free | 10 | 16 | D 1640 | 4061 |
| Flash Point, degrees F | 105 (41°C) | — | D 3278 | — |
| Sag Resistance, mils | 10 (254 micrometers) | — | | 4494 |

†Viscosity 48 hours or more after manufacture.

the steel shall be spot-cleaned and spot-primed with rust inhibitive primer.

Mix paint thoroughly before use. This thixotropic paint settles only slightly and moderate hand stirring should be sufficient.

Thin paint only if necessary, using only mineral spirits with a minimum flash point at 140°F (60°C) and a boiling range of 360-420°F (182-215°C). Under normal conditions, no thinning should be necessary. Add up to one-half pint of thinner per gallon (60 ml/L) of paint when necessary.

Apply by brush or spray to the specified film thickness or, if none is specified, to at least 3 mils (76 micrometers) dry or approximately 7 mils (178 micrometers) wet. The surface to be painted shall be dry; the surface temperature shall be at least 5°F (3°C) above the dew point, and the temperature of the air shall be over 40°F (4°C). Do not paint outdoors in rainy weather or if freezing temperaures are expected before the paint dries.

Allow paint at least 24 hours drying time in good weather before recoating.

## 7. Inspection

**7.1** All materials (coatings) supplied under this specification are subject to timely inspection by the purchaser or his authorized representative. The purchaser shall have the right to reject any materials supplied which are found to be defective under this specification. (See Note 9.1.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

**7.3** Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the specification or standard itself.

**8.2** This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## 9. Notes

Notes are not requirements of this specification.

**9.1** The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-PA COM
November 1, 1982
Revised September 1, 2000

## SSPC: The Society for Protective Coatings

# PAINT APPLICATION SPECIFICATIONS AND GUIDES

## Commentary on Paint Application

### 1. Introduction

This commentary is for information only and is not part of SSPC-PA 1, PA 2, PA Guide 3, PA Guide 4 or PA Guide 5. Its purpose is to present a general description of the sections which comprise this chapter: (1) SSPC PA 1, "Shop, Field, and Maintenance Painting of Steel"; (2) SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages"; (3) SSPC-PA Guide 3, "A Guide to Safety in Paint Application"; (4) SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems"; and (5) SSPC-PA Guide 5, "Guide to Maintenance Painting Programs."

### 2. SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel"

This specification should be used when paint service is severe or when rigid requirements for appearance are established. When painting is necessary for protection from corrosive environments or for good appearance, then it is in the best interests of the purchaser to see that paint is applied in strict conformance with good practice. While surface preparation is probably the most critical factor which governs the performance of paints, improper paint application may result in paint failure, even over blast cleaned surfaces.

Pre-application procedures are covered that are necessary before actual application of paint can begin. They include handling and use of materials, surface preparation, and proper mixing and thinning of paints. Also, general conditions for good application are covered in detail in this specification and include proper air temperature, moisture, humidity, cover, and surface temperature.

This specification permits application by brush, air spray, airless spray, hot spray, plural component spray, high volume low pressure spray, or a combination of these methods. Roller coat applications may be used over flat or slightly curved steel surfaces.

Inspection procedures for paint applications are discussed in detail in Volume 1 of the SSPC Painting Manual and in publication SSPC 97-07, “The Inspection of Coatings and Linings, A Handbook of Basic Practice for Inspectors, Owners, and Specifiers.”

This specification is a revision of SSPC-PA 1-91. New to this revision are sections on induction time and pot life, air-assisted airless spray, and plural component spray. What used to be called conventional spray is now defined as air atomizing spray.

### 3. SSPC-PA 2, "Measurement of Dry Coating Thickness With Magnetic Gages"

This method describes the types of available magnetic gages, how to verify the calibration of the gages, and procedures for measuring the dry film thickness of paint.

The gages are classified as either Type 1 — pull-off gages or Type 2 — constant pressure probe gages, formerly called fixed probe gages. Type 1 is further divided into Type 1A, which is a "dial" type, and Type 1B which is a "pencil" type. All these types are magnetic gages and measure the thickness of dry film of a non-magnetic coating applied on a magnetic substrate.

This standard specifies the number of measurements to be made to determine compliance with the specified minimum and maximum dry film thicknesses.

This method is the latest revision of SSPC-PA 2-82. Some changes and additions have been made to update and refine this method based upon actual usage of the previous revision. These include the following modifications:

- Changes in gage terminology
- Restrictions on calibration with magnetic shims
- Procedure for specifying maximum thickness
- Spot measurement definition
- Base Metal Reading
- Number of measurements on very large structures
- Appendix with a numerical example of computing thickness
- Appendix with example of calibration calculations

### 4. SSPC-PA Guide 3, "A Guide to Safety in Paint Application"

This guide has been prepared so that the user will have a source of information available when preparing a section on safety for a procurement document. The guide covers in considerable detail the necessary precautions to be taken in order to protect personnel and property from accidents due to falls, toxic fumes, fires, explosion, or other harm in the application of coatings to steel structures. Also covered is protective equipment to be used by the workers. Safety precautions are given for the equipment for applying paint and also for the equipment for providing access to the work area.

Provided by : www.spic.ir Licensee: NISOC Library

## 5. SSPC-PA Guide 4, "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems"

This guide has been prepared specifically for use as a guide for repainting with oil base, alkyd, and other solvent-thinned paint systems. It is concerned with procedures necessary to maintain previously painted steel structures so that they continue to provide the corrosion protection as originally intended. Items covered are a guide for determining when maintenance painting is required and preparing the existing surface for painting.

## 6. SSPC-PA Guide 5, "Guide to Maintenance Painting Programs"

This guide, intended for use primarily by the owner's representative, covers procedures for planning and carrying out a maintenance painting program for steel and other structures. It may be used for one time repaint programs or long range repaint programs.

Planning and implementation of maintenance painting programs are presented in a logical sequence of eight specific tasks. These tasks range from defining the program objectives to follow-up activities required to implement an on-going maintenance program. Each task is designed in such a way that it may be utilized as stand-alone for those with interest in only one or a few aspects of the program.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT APPLICATION SPECIFICATION NO. 1

## Shop, Field, and Maintenance Painting of Steel

## 1. Scope

**1.1** This specification covers procedures for the painting of steel surfaces. The scope of this specification is rather broad, covering both specific as well as general requirements for the application of paint. This specification does not provide detailed descriptions of surface preparation, pretreatments, or selection of primers and finish coats. This specification does provide detailed coverage of the procedures and methods for application after the selection of the coating materials has been made.

## 2. Description

**2.1** This specification for shop, field, and maintenance painting is intended to be used for steel which, because of its exposure condition, will be subjected to corrosive attack, either from the weather or from the service environment, and where a high quality of cleaning and painting is essential. It is not contemplated that the requirements of this specification are necessary for the cleaning and painting of steel which will not be subjected to corrosive attack. The following is a summary of the major sections of this specification.

1. Scope
2. Description
3. Reference Standards
4. Definitions
5. Pre-Application Procedures
   5.1 Materials Handling and Use
   5.2 Surface Preparation
   5.3 Pretreatments
   5.4 Coating Materials Preparation
6. Factors Affecting the Application of Coatings
   6.1 Temperature
   6.2 Moisture
   6.3 Humidity
   6.4 Cover
   6.5 Defects
   6.6 Striping
   6.7 Continuity
   6.8 Thickness
   6.9 Recoating
   6.10 Tinting
   6.11 Intercoat Adhesion
   6.12 Contact Surfaces
   6.13 Induction Time and Pot Life
7. Application Methods
   7.1 General
   7.2 Brush Application
   7.3 Roller Application
   7.4 Spray Application (General)
   7.5 Air Atomizing Spray Application
   7.6 Airless Spray Application
   7.7 Air-Assisted Airless Application
   7.8 Hot Air Spray Application
   7.9 Hot Airless Spray Application
   7.10 Plural Component Spray Application
   7.11 High Volume Low-Pressure Spray
8. Shop Coating
   8.1 Applicability
   8.2 Number of Coats and Type of Coating
   8.3 Damage to Shop Coating
   8.4 Contact Surfaces
   8.5 Requirements for Welding
   8.6 Rust Preventive Compounds
   8.7 Erection Marks
9. Field Coating
   9.1 Applicability
   9.2 Surface Preparation
   9.3 Touch-up of Shop Coated Surfaces
   9.4 Field Coating Procedures
10. Repair of Damaged Intact Coatings
   10.1 Applicability
   10.2 Surface Preparation for Recoating
   10.3 Incompatibility
   10.4 Work to be Performed
11. Application Procedures for Generic Groups of Coatings
   11.1 General
   11.2 Drying Oil Curing Coatings
   11.3 Vinyls and Chlorinated Rubber Coatings
   11.4 Bituminous Coatings
   11.5 Epoxy and Coal Tar Epoxy Coatings
   11.6 Zinc-Rich Coatings
   11.7 Urethane Coatings
   11.8 Waterborne Thermoplastic Coatings
12. Curing and Handling of Coatings
   12.1 Drying of Coatings
   12.2 Handling of Coated Steel
13. Inspection
14. Safety and Environmental Concerns
15. Disclaimer
16. Notes
Appendix A - Additional Reference Materials

Provided by : www.spic.ir Licensee: NISOC Library

## 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 through 3.7 and form a part of this specification.

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

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

**3.4 SSPC: THE SOCIETY FOR PROTECTIVE COATINGS STANDARDS:**

| | |
|---|---|
| **PA 2** | Measurement of Dry Coating Thickness With Magnetic Gages |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **SP 1** | Solvent Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 16** | Terminology Relating to Paint, Varnish, Lacquer, and Related Products |
| **D 4285** | Method for Indicating Oil or Water in Compressed Air |

**3.7 NACE INTERNATIONAL STANDARD:**

| | |
|---|---|
| **RP0178** | Fabrication Details, Surface Finishing Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service |

## 4. Definitions

**4.1 SHOP, FIELD AND MAINTENANCE COATING:** The application of coatings to steel surfaces whether in the shop or in the field.

**4.2 PAINT:** In the general sense, paint includes primers, enamels, varnishes, emulsions, catalyzed coatings, bituminous coatings, and other organic coatings. Inorganic coatings which are also applied as liquid films are included in this definition. This definition is compatible with most commonly used industry glossaries.

**4.3 SHOP COATING:** The surface preparation and coating of steel surfaces inside a shop or plant before shipment to the site of erection.

**4.4 FIELD COATING:** The on-site coating of new or previously coated steel structures before or after erection.

**4.5 MAINTENANCE COATING:** The coating of steel structures in service that have been previously coated and require touch-up or recoating.

**4.6 MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS:** These (or similar terms) are used to refer to an equipment supplier's or coating manufacturer's latest published or written instructions and recommendations. Verbal recommendations or instructions from an equipment or coating manufacturer are not acceptable unless backed up in writing by the manufacturer's technical staff.

## 5. Pre-Application Procedures

See Section 11 for procedures unique to specific generic coatings.

**5.1 MATERIALS HANDLING AND USE**

**5.1.1** All coating shall be delivered to the shop or jobsite in original, unopened containers with labels intact. Minor damage to containers is acceptable provided the container has not been punctured or the lid seal broken.

**5.1.2** Each container of coating shall be clearly marked or labelled to show coating identification, date of manufacture, batch number, and other information as needed to meet regulatory requirements. Each type of coating shall be accompanied by the manufacturer's Material Safety Data Sheet (MSDS) and product data sheet containing information such as basic chemical composition, weather conditions acceptable for application, and proper storing and mixing.

**5.1.3** All containers of coating shall remain unopened until required for use. No more containers of coating shall be opened than will be applied that day. The label information shall be legible and shall be checked at the time of use.

**5.1.4** Coating which has livered, gelled, or otherwise deteriorated during storage shall not be used; however, thixotropic materials which can be stirred to attain normal consistency may be used.

**5.1.5** The oldest coating of each kind that is in acceptable condition shall be used first. In every case, coating is to be used before its shelf life has expired. Before using a coating which has exceeded its shelf life, the manufacturer shall verify its quality and then certify its use for a given period of time.

**5.1.6** Coatings shall be stored in original unopened containers in weathertight spaces where the temperature is maintained between 40 °F and 100 °F (4 °C and 38 °C) unless otherwise recommended in writing by the manufacturer. The coating temperature shall be brought to the manufacturer's written recommended application temperature before use. (See Note 16.1 for more information on coating storage.)

**5.2 SURFACE PREPARATION**

**5.2.1** The surface shall be cleaned as specified in the procurement documents. In no event shall the surface preparation be less than the paint manufacturer's recommendations for the intended service environment.

**5.2.2** The surface to be coated shall have the specified surface preparation at the time of application of the coat-

Provided by : www.spic.ir Licensee: NISOC Library

ing. If the surface is degraded or contaminated subsequent to surface preparation and prior to coating, the surface shall be restored to the specified condition before coating application (see Note 16.2).

**5.2.3** In order to control the degradation or contamination of cleaned surfaces, the pretreatments, or, in the absence of a pretreatment, the prime coat shall be applied as soon as possible after the surface has been cleaned and before degradation or contamination has occurred. Succeeding coats shall be applied before contamination of any existing coating occurs.

**5.2.4** Previously applied coating shall be roughened prior to coating whenever necessary for the development of proper intercoat adhesion (see Section 6.11).

**5.2.5** Cleaning and coating shall be scheduled to minimize the amount of dust and other contaminants that may fall on newly applied wet coating films. Surfaces not intended to be coated shall be suitably protected from the effects of cleaning and coating operations.

### 5.3 PRETREATMENTS

**5.3.1** When specified, the surface shall be pretreated prior to application of the prime coat of coating.

**5.3.2**. The provisions of Sections 5.1 and 5.2 shall also apply to pretreated surfaces and the materials used for this purpose.

**5.3.3** When chemical pretreatments are used, sufficient time shall elapse between pretreatment and application of the prime coat to permit any chemical action to be completed and the surface to dry. Two-component pretreatments shall be applied within the specified interval after mixing. When proprietary pretreatments are used, the instructions of the manufacturer shall be followed.

**5.3.4** Inhibitive water washes used to prevent rusting of cleaned surfaces prior to coating shall not be considered pretreatments. These may be used only if they do not adversely affect the long term performance of the coating and are specifically authorized. Test patches may be used to check adhesion of the coating prior to coating the entire surface.

### 5.4 COATING MATERIALS PREPARATION

**5.4.1** Single component coatings shall be thoroughly mixed to obtain a uniform composition. For multiple component coatings, each component shall be thoroughly mixed before combining and further mixing. In all cases, the manufacturer's written instructions for mixing shall be followed, and the products shall be checked for complete uniformity.

**5.4.2** The following are acceptable methods for mixing most coatings:

**5.4.2.1 Manual (Hand) Mixing:** Most of the vehicle shall be poured off into a clean container. The pigment in the coating shall be lifted from the bottom of the container with a broad, flat paddle, lumps shall be broken up, and the pigment thoroughly mixed with the remaining vehicle. The poured off vehicle shall be returned to the coating with simultaneous stirring, or boxed until the composition is uniform. "Boxing" is the process of mixing coating by pouring from one container to another. The maximum container size for "boxing" shall be five gallons.

**5.4.2.2 Power Mixing:** This will usually give better mixing in a much shorter time than mixing by hand.

**5.4.3** All pigmented coating shall be strained after mixing except where application equipment is provided with strainers. Strainers shall be of a size to remove only skins and undesirable matter but not to remove the pigment.

**5.4.4** Where a skin has formed in the container, the skin shall be cut loose from the sides of the container, removed and discarded. If the volume of such skins is visually estimated to be more than 2% of the remaining coating, the coating shall not be used.

**5.4.5** Mixing of solvent-containing coatings in open containers shall be done in a well ventilated area away from sparks or flames.

**5.4.6** Coating shall not be mixed or kept in suspension by means of an air stream bubbling under the coating surface.

**5.4.7** Dry pigments which are separately packaged shall be mixed into coatings in such a manner that they are uniformly blended and all particles of the dry powder are wetted by the vehicle.

**5.4.8** Pastes shall be made into coatings in such a manner that the paste shall be uniformly blended and all lumps and particles broken up to form a homogenous coating.

**5.4.9** Coating which does not have a limited pot life or does not deteriorate on standing may be mixed at any time before using, but if settling or phase separation has occurred it must be remixed immediately before using.

**5.4.10** Coating shall not remain in spray pots, painters' buckets, etc., overnight, but shall be stored in a covered container and remixed before use.

**5.4.11** Catalysts, curing agents, or hardeners which are separately packaged shall be added to the base coating only after the latter has been thoroughly mixed. The proper volume of the catalyst shall then be slowly poured into the required volume of base with constant agitation. Mixing of complete kits is preferred to avoid mixing incorrect ratios of components. Do not pour off the liquid which has separated from the pigment and then add the catalyst to the settled pigment to aid mixing. The mixture shall be used within the pot life specified by the manufacturer. For example, more

Provided by : www.spic.ir Licensee: NISOC Library

than 20 minutes and less than eight hours after mixing are the pot life limits for some chemically cured coatings (see Section 6.13). Therefore only enough coating should be catalyzed for prompt use. Most mixed, catalyzed coatings cannot be stored, and unused portions of these shall be placed in proper storage containers for later appropriate disposal. When specified, special continuous mixing equipment shall be used according to the manufacturer's directions.

**5.4.12** Thinning of the coating shall be done only when necessary for proper application and when it will not result in violation of air pollution control regulations. Coatings to be applied by brush will usually require no thinning. Coatings to be sprayed, if not specifically formulated for spraying, may require thinning when proper adjustment of the spray equipment and air pressure does not result in satisfactory coating application. In no case shall more thinner be added than that recommended by the manufacturer's written instructions.

**5.4.13** The type of thinner shall comply with the manufacturer's instructions.

**5.4.14** When the use of thinner is permissible, thinner shall be added slowly to coating during the mixing process. All thinning shall be done under supervision of a knowledgeable person acquainted with the correct amount and type of thinner to be added to the coating and familiar with pertinent regulations relating to solvent emissions. Thinner should be at the same temperature as the coating material. At very low temperatures, thinners can shock sensitive coating materials, resulting in gelling.

## 6. Factors Affecting Application of Coatings

See Section 11 for factors unique to specific generic coatings.

**6.1 TEMPERATURE:** The application of a coating system shall occur only when the air and substrate temperature is within the range indicated by the manufacturer's written instructions for both application and curing and can be expected to remain in that range. Special coating materials are available that would allow for application below 60°F with or without further adjustment. (See Note 16.3.)

**6.2 MOISTURE:** Coating shall not be applied in rain, wind, snow, fog, or mist, or when the steel surface temperature is less than 5 °F (3 °C) above the dew point. Coating shall not be applied to wet or damp surfaces unless the coating is formulated and certified by the manufacturer for this type of application. Coating shall not be applied on frosted or ice-coated surfaces (see Note 16.4).

**6.3 HUMIDITY:** Because curing of coatings may be adversely affected by humidities that are too low or too high, no coating shall be applied unless the manufacturer's written requirements for humidity are met.

**6.3.1** Some coatings (e.g., some inorganic zinc and polyurethane coatings) cure by chemically reacting with water, and so require a minimum humidity for complete curing.

**6.3.2** High humidities may cause moisture to condense on or react with uncured coating films to cause blushing or other adverse effects.

**6.4 COVER:** When coating must be applied in damp or cold weather, the steel must be coated when the surrounding air and the steel are heated to a satisfactory temperature. In all such cases, the temperature and moisture conditions of Sections 6.1 and 6.2 must be met. Where cover is required to achieve these conditions, the steel shall remain under cover or be protected until dry or weather conditions permit its exposure.

**6.5 DEFECTS:** Defects in films that are not permitted by the contract specification shall be corrected in a manner satisfactory to the owner.

**6.6 STRIPING:** If stripe coating is specified in the procurement documents, all corners, crevices, rivets, bolts, welds, and sharp edges shall be stripe coated with the priming coating before the steel receives its first full prime coat of coating. Such striping shall extend a minimum of one inch (2 cm) from the edge. The stripe coat shall set to touch before the full prime coat is applied. However, the stripe coat shall not be permitted to dry for a period long enough to allow rusting of the unprimed steel. Alternatively, the stripe coat may be applied after a complete prime coat.

Stripe coating of edges, corners, rivets, welds, etc., is advantageous in preventing breakdown of coating on such edges in very corrosive surroundings. Striping is an expensive operation and may only be justified when it is believed the cost will be compensated for by extra life. To prevent removal of the stripe coat of coating by later application of the prime coat, the striped coating should be allowed to at least set to touch before application of the full prime coat; a longer drying period is advantageous, however. Where it is felt that a long drying period of stripe is necessary, but the precoated steel will deteriorate in the interval, the full prime coat of coating may be applied, allowed to dry, and the stripe coating then applied. Tinting of the striping coating is advisable to promote contrast (see Section 6.10). Stripe coating is most effective on edges that are rounded by grinding.

**6.7 CONTINUITY:** To the maximum extent practical, each coat shall be applied as a visually continuous film of uniform thickness free of pores. All thin spots or areas missed in the application shall be recoated and permitted to dry before the next coat of coating is applied.

**6.8 THICKNESS:** Unless otherwise specified in the procurement documents, all dry film thickness determinations shall be performed as specified in PA 2, Measurement of Dry Coating Thickness with Magnetic Gages. Coating thickness is usually specified (or implied) as a minimum. Greater thickness that does not detrimentally affect the

Provided by : www.spic.ir Licensee: NISOC Library

appearance or service life of the coating is permitted unless otherwise specified.

**6.8.1** If not otherwise specified, each prime coat shall be within a thickness range of 1.5 mils (38 micrometers) to 2.5 mils (64 micrometers) when dry. Each intermediate and finish coat shall be within a thickness range of 1.0 mils (25 micrometers) to 2.0 mils (51 micrometers). As indicated in Section 11, vinyls, lacquers, emulsions, high-build coatings, and bituminous coatings usually deviate from these thicknesses.

**6.8.2** In the event the required minimum thickness is not achieved as specified, additional coats shall be applied in accordance with the manufacturer's instructions until the required thickness is obtained. The inorganic zinc-rich coatings shall not be corrected in this manner unless the manufacturer's instructions specifically permit this practice.

**6.9 RECOATING:** Each coating layer shall be in a proper state of cure or dryness before the application of the succeeding coat so that it is not adversely affected by topcoating. Consult the coating manufacturer for the appropriate time interval before recoating.

**6.10 TINTING:** When successive coats of coating of the same color have been specified, alternate coats of coating shall be tinted, when practical, to produce enough contrast to indicate complete coverage of the surface. Tinting shall be performed in such a manner that it will not be necessary to tint the final coat. Field tinting shall be done only with coatings of the same type from the same manufacturer. When the coating is the color of the steel, the first coat to be applied shall be tinted. The tinting material shall be compatible with the coating and not detrimental to its service life. It is suggested that the coating be tinted by the manufacturer and appropriately labeled. Single component coatings to be blended for tinting shall be thoroughly mixed separately before combining and further mixing. For multiple-components, it is necessary to blend similar components of the two different colors together before combining and mixing these blends.

**6.11 INTERCOAT ADHESION:** When applying multiple coats of two component thermosetting systems, topcoats shall be applied within the recoat window specified by the manufacturer of the undercoat in order to obtain good intercoat adhesion. If, for any reason, this time period is exceeded, the undercoat surface shall be specially treated as recommended by its manufacturer before topcoating. Such treatments include mild abrasion, solvent treatment, and use of a fog coat.

**6.12 CONTACT SURFACES:** Unless otherwise required by the contract specification, the following practice shall be followed regarding coating of contact surfaces.

**6.12.1** Steel to be embedded, encased or completely enclosed in brick or masonry shall be given at least one coat of coating that is compatible with masonry materials.

**6.12.2** The areas to be in contact with wood shall receive the full specified coating system before assembly.

**6.12.3** Surfaces to be in contact only after field erection shall receive the full-specified coating system before assembly.

**6.12.4** Steel surfaces not in direct bonded contact, but inaccessible after assembly, shall receive the full-specified coating system before assembly.

**6.12.5** Contact surfaces of members to be joined by high strength bonds in a friction connection are a special case. Unless specifically authorized to the contrary, they shall be left uncoated and free of oil, grease, and coatings. However, faying surfaces of friction connection may be coated with approved coatings which do not release the coefficient of friction between contact surfaces, in accordance with the American Institute of Steel Construction (AISC) and the Research Council on Structural Connections (RCSC).

**6.13 INDUCTION TIME AND POT LIFE:** The induction time (sometimes called "sweat-in time") and pot life requirements of the manufacturer shall be met.

## 7. Application Methods

See Section 11 for application methods unique to specific generic coatings.

**7.1 GENERAL:**

**7.1.1** The following methods of application are covered by this specification: brush, roller, air spray, airless spray, plural component spray, hot spray, or any combination of these methods. Daubers or natural or synthetic wool mitts or other applicators may be used for places of difficult access when no other method is practical. Whichever application method is used, the dry film thickness of each coat shall meet the requirement of the specification or the manufacturer's recommendation, whichever has precedence, as agreed upon by owner and contractor. Also see Note 16.5.

**7.1.2** The following methods of application are not covered by this specification: dipping, flow coating, electrostatic spray, and fluidized bed. If application by one of these methods is specified, it shall be done in accordance with the procurement documents or, if none are present, with the manufacturer's recommendations.

**7.2 BRUSH APPLICATION:** Brush application of coating shall be in accordance with the following:

**7.2.1** Brushes shall be of a style and quality that will enable proper application of coating. Round or oval brushes are generally considered most suitable for rivets, bolts, irregular surfaces, and rough or pitted steel. Wide, flat brushes are suitable for large flat areas, but they should not have a width over five inches.

Provided by : www.spic.ir Licensee: NISOC Library

**7.2.2** The brushing shall be done so that a smooth coat as uniform in thickness as possible is obtained.

**7.2.3** Coating shall be worked into all crevices and corners.

**7.2.4** All runs or sags shall be brushed out. (See 7.3.4.)

**7.2.5** An attempt shall be made to minimize brush marks and other surface irregularities.

**7.3 ROLLER APPLICATION:** Roller application shall be in accordance with the following:

**7.3.1** Rolling shall be done so that a smooth coat as uniform in thickness as possible is achieved.

**7.3.2** Roller covers shall be selected which do not shed fibers into the paint. Their nap should be appropriate for the particular surface roughness.

**7.3.3** Roller application may be used on flat or slightly curved surfaces and shall be in accordance with the recommendations of the coating manufacturer and roller manufacturer. Coating rollers shall be of a style and quality that will enable proper application of coating having the continuity and thickness required in Sections 6.7 and 6.8.

**7.3.4** Roller application shall not be used on irregular surfaces such as rivets, bolts, crevices, welds, corners, or edges, unless otherwise specified. When permitted, however, the coating applied by roller on these irregular surfaces shall be subsequently brushed out to form a continuous and unbroken film (see Note 16.6).

**7.4 SPRAY APPLICATION (GENERAL):** All spray application of coating, whether air spray, airless spray, plural-component spray, hot air spray or hot airless spray, shall be in accordance with the following:

**7.4.1** The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the coating to be applied, and shall be equipped with suitable pressure regulators and gages. The equipment shall be maintained in proper working condition. Spray equipment shall meet the material transfer requirements of the local air pollution or air quality management district.

**7.4.2** Coating ingredients shall be kept uniformly mixed in the spray pots or containers during coating application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

**7.4.3** Spray equipment shall be kept sufficiently clean so that dirt, dried coating, and other foreign materials are not deposited in the coating film. Any solvents left in the equipment shall be completely removed before using.

**7.4.4** Coating shall be applied in a uniform layer with overlapping at the edges of the spray pattern. During application, the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet layer of coating is deposited on the surface. The trigger of the gun should be released at the end of each stroke.

**7.4.5** All runs and sags shall be brushed out immediately, and if not, the coating shall be removed and the surface repainted. The wet film may be removed or allowed to dry and removed by sanding after curing.

**7.4.6** Cracks, crevices, blind areas of all rivets and bolts, and all other inaccessible areas shall be coated by brush or daubers.

**7.4.7** Particular care shall be observed with respect to type of thinner, amount of thinner, coating temperature, and operating techniques in order to avoid deposition of coating which is too viscous, too dry, or too thin. It may be necessary to use an approved different coating material or other equipment to resolve these problems.

**7.4.8** Coatings formulated for application to hot surfaces may not be suitable for application to surfaces below the designed temperature. Conversely, coatings formulated for application at ambient or low temperatures may not be suitable for application to hot surfaces. Thus, coatings shall not be applied outside the manufacturer's recommended temperature range without the written approval of the manufacturer and the owner.

**7.5 AIR ATOMIZING SPRAY APPLICATION:** Compressed air atomizing spray application of coating shall be in accordance with all the provisions of Section 7.4 and in addition shall comply with the following:

**7.5.1** The air caps, nozzles, and needles shall be those recommended by the manufacturers of the material being sprayed and the manufacturers of the equipment being used.

**7.5.2** Traps or separators shall be provided to remove any oil or condensed water from the air. The traps or separators must be of adequate size and must be bled continuously or drained periodically during operations. The air from the spray gun impinging against a clean surface shall show no condensed water or oil. ASTM D 4285 provides a test procedure for indicating the presence of oil or water in compressed air.

**7.5.3** The pressure on the material in the pot and of the air at the gun shall be adjusted for optimum spraying effectiveness. The pressure on the material in the pot shall be adjusted when necessary for changes in elevation of the gun with respect to the elevation of the pot. The atomizing air pressure at the gun shall be high enough to properly atomize the coating, but not so high as to cause excessive fogging of coating, excessive evaporation of solvent or loss by overspray.

**7.6 AIRLESS SPRAY APPLICATION:** Airless or high pressure spray application of coating shall be in accordance with all of the provisions of Section 7.4 and in addition shall comply with the following:

**7.6.1** Fluid tips shall be of proper orifice size and fan angle, and the fluid control gun of proper construction, as recommended by the manufacturer of the material being

Provided by : www.spic.ir Licensee: NISOC Library

sprayed and the manufacturer of the equipment being used. Fluid tips shall be of the safety type with shields to prevent accidental penetration of the skin by the high pressure stream of coating.

**7.6.2** The air pressure to the coating pump shall be adjusted so that the coating pressure to the gun is proper for optimum spraying effectiveness. This pressure shall be sufficiently high to properly atomize the coating. Pressures considerably higher than those necessary to properly atomize the coating should not be used.

**7.6.3** Spraying equipment shall be kept clean and shall utilize proper filters in the high pressure line so that dirt, dry coating, and other foreign materials are not deposited in the coating film. Any solvents left in the equipment shall be completely removed before applying coating.

**7.6.4** The trigger of the gun should be pulled fully open and held fully open during all spraying to ensure proper application of coating. During application, the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet layer of coating is deposited on the surface. The trigger of the gun should be released at the end of each stroke.

**7.6.5** Airless coating spray equipment shall always be provided with an electric ground wire in the high pressure line between the gun and the pumping equipment. Further, the pumping equipment shall be suitably grounded to avoid the build-up of any electrostatic charge on the gun. The manufacturer's instructions are to be followed regarding the proper use of the equipment. PA 3 provides information on how to use airless spray equipment safely.

**7.7 AIR ASSISTED AIRLESS SPRAY:** Air-assisted airless spray atomizes paint by a combination of hydraulic and air pressures. Air-assisted airless spray shall be performed in accordance with all provisions of Sections 7.3 and 7.4.

**7.8 HOT AIR SPRAY APPLICATION:** Hot air spray application shall be in accordance with the provisions of Sections 7.4 and 7.5.

**7.9 HOT AIRLESS SPRAY APPLICATION:** Hot airless spray application shall be in accordance with Sections 7.4 and 7.6.

**7.10 PLURAL COMPONENT SPRAY APPLICATION**

**7.10.1** Plural component spray shall be in accordance with all the provisions of Section 7.4 and use either fixed or variable ratio systems depending upon the ratio of components.

**7.10.2** Plural component spray is used primarily for thick-film applications of fast-setting coatings.

**7.11 HIGH-VOLUME LOW-PRESSURE SPRAY**

**7.11.1** High-volume low-pressure spray shall be in accordance with all the provisions of Section 7.4.

**7.11.2** High-volume low-pressure spray has a high transfer efficiency and can be used where other equipment with lower transfer efficiency is not permitted, as well as under less restrictive conditions.

## 8. Shop Coating

**8.1 APPLICABILITY:** All provisions of this specification shall be applicable to shop coating except those under Sections 9 and 10.

**8.2 NUMBER OF COATS AND TYPE OF COATING:** The number of coats, type of coating, and surfaces to be coated shall be specified in the procurement documents. If coating thickness is not specified, the guidance in Section 6.8.1 shall be followed. The coating application shall be scheduled to provide protection to the substrate at all construction stages. (See Note 16.7.)

**8.3 DAMAGE TO SHOP COATING:** Damage resulting from fabrication, handling and storage in the shop shall be repaired before leaving the shop. If the shop coating is damaged in shipping, unloading or field handling or fabrication, it shall be repaired before the field coating operations are begun.

**8.4 CONTACT SURFACES:** Contact surfaces shall be coated or left uncoated as specified in the procurement documents. When coated, the specification may require that at least the first coat shall be applied in the shop or the field, with subsequent coats being applied in the field while the surfaces are still accessible, unless otherwise specified (see Section 6.12).

**8.5 REQUIREMENTS FOR WELDING**

**8.5.1** If the coating specified is harmful to the welders (usually the case) or is detrimental to the welding operation or the finished welds, the steel shall not be coated within four inches (100 millimeters) of the areas to be welded, except when using inorganic zinc-rich primer, which may be applied to within one inch (25 millimeters) of the weld area.

**8.5.2** Shop welds and areas within four inches of such welds shall be cleaned in the shop using surface preparation methods at least as effective as those specified for the structure itself. All welds shall either be blast cleaned, thoroughly power tool cleaned, chemically scrubbed, or water scrubbed of all detrimental welding deposits.

**8.6 RUST PREVENTIVE COMPOUNDS:** Machine finished or similar surfaces that should not be coated, but do require protection, shall be protected as specified.

**8.7 ERECTION MARKS:** Erection and weight marks shall be placed on areas that have been previously shop primed unless otherwise specified. Compatible and non-bleeding markers or coating sticks shall be used.

Provided by : www.spic.ir Licensee: NISOC Library

## 9. Field Coating

**9.1 APPLICABILITY:** All provisions of this specification shall pertain to the field coating of steel structures except for inapplicable provisions of Sections 8 and 10.

**9.2 SURFACE PREPARATION:** Previously applied shop coatings must be dry or cured sufficiently for overcoating and be free of dirt, oil, chlorides, or other contaminants. The manufacturer's instructions shall be followed if special surface preparation procedures are required before application of the field coats. Damaged areas of shop applied coatings are to be touched-up in compliance with the requirements of Section 9.3. See SSPC-TU 4 for additional information on detection of soluble salts on steel surfaces.

**9.3 TOUCH-UP OF SHOP COATED SURFACES:** Steel that has been shop coated shall be touched up with the same coating as the shop coat unless otherwise specified. This touch-up shall include preparing, cleaning and coating of field connections, welds or rivets, and all damaged or defective coating and rusted areas as specified.

**9.4 FIELD COATING PROCEDURES**

**9.4.1** Shop coated steel members shall preferably be field coated after erection of such members is completed. Steel members may be shop or field coated on the ground before erection, provided any damaged coating is touched-up with the same number of coats and kinds of coatings after erection. Whenever possible, the last full (finish) coat of coating shall be applied after erection of the structure and repair of damaged areas of existing coating.

**9.4.2** The first field coat shall be applied to shop-coated steel in a timely manner, as required by the specification, to protect the steel from corrosion.

**9.4.3** In the unlikely case that the types of field coatings are not specified, they shall be determined to be compatible with the shop coating and the service environment.

**9.4.4** Contact surfaces shall be cleaned and coated as specified, unless otherwise stated in the procurement documents (see Section 6.12).

**9.4.5** When specified, surfaces (other than contact surfaces) of fabricated assemblies that are accessible before erection but which will not be accessible after erection shall receive the entire specified coating system before erection.

**9.4.6** Coating shall be applied to all cracks and crevices as required by the specification.

**9.4.7** The final coat of coating shall not be applied until all concrete work is finished. In addition to the cleaning specified in Section 5.2, all cement or concrete spatter and drippings shall be removed before any application of coating. If any coating is damaged, the damaged surface shall be cleaned and recoated before the final coat is applied.

**9.4.8** Wet coating shall be protected against damage from dust or other detrimental foreign matter as much as is practical.

**9.4.9** Steel stored pending erection shall be kept free from contact with the ground and so positioned as to minimize water-holding pockets, soiling, contamination, and deterioration of the coating film. Such steel shall be cleaned and recoated or touched-up with the specified coating whenever it becomes necessary to maintain the integrity of the film.

**9.4.10** All field welds and all areas within four inches of welds shall be cleaned before painting, using surface preparation methods at least as effective as those specified for the structure itself. All welds shall either be blast cleaned, thoroughly power tool cleaned, chemically scrubbed, or water scrubbed of all detrimental welding deposits.

## 10. Repair of Damaged Intact Coatings

**10.1 APPLICABILITY:** All provisions of this specification shall pertain to maintenance coating except the inapplicable portions of Sections 8 and 9.

**10.2 SURFACE PREPARATION FOR RECOATING**

**10.2.1** Only loose, cracked, brittle, or non-adherent coating shall be removed in cleaning unless it is otherwise specified. Cleaning shall be performed two inches (50 micrometers) beyond the damaged areas in all directions or until tightly adhered coating is obtained. Where the remaining coating is thick, all exposed edges shall be feathered. Rust spots shall be thoroughly cleaned and the edges of all old coating shall be scraped back to sound material (see Note 16.9).

**10.2.2** The contractor shall have the option to remove all coating from large areas containing smaller areas of coating which are required to be removed by the contract specification.

**10.3 INCOMPATIBILITY:** Only coatings compatible with the existing coatings and the service environment shall be used. All defects arising from unexpected incompatibility shall be corrected as specified.

**10.4 WORK TO BE PERFORMED:** The amount of cleaning and coating should be described in the procurement documents covering the work. It is important that the procurement documents cover precisely the work to be performed to avoid misunderstandings. In the absence of such specific provisions, the guidelines given in Note 16.9 may be used.

## 11. Application Procedures for Generic Groups of Coatings

**11.1 GENERAL:** The materials covered herein are to be applied as specified. In case of conflict with any other portion of this specification, these special provisions shall

Provided by : www.spic.ir Licensee: NISOC Library

govern. Minimum and maximum dry film thicknesses are indicated, but thicker coatings should be applied when recommended by the manufacturer's instructions. Materials which are not specifically covered in this specification shall be applied in accordance with the directions of the manufacturer.

**11.2 DRYING OIL CURING COATINGS:** Coatings that cure by air oxidation of drying oils (e.g., alkyds, unmodified drying oils, epoxy esters, etc.) shall be applied in accordance with the preceding provisions of this specification.

**11.3 VINYLS AND CHLORINATED RUBBER COATINGS:** Where permitted by local regulations, vinyl and chlorinated rubber finish coatings shall be applied by spray, with application by brush limited to small areas and touch-up. Primers may be brushed or sprayed. These coatings shall be thinned as recommended by the manufacturer. They shall be applied at a coverage that will result in the dry film thickness specified or, if not specified, the dry film thickness recommended by the manufacturer. When vinyl or chlorinated rubber coatings are applied by brush, coatings shall be applied to the surface with a minimum of brushing so that there is little or no lifting or softening of the undercoats.

**11.4 BITUMINOUS COATINGS**

**11.4.1 Bituminous coating (thin film):** The term bituminous coating (thin film) refers to low consistency solutions of coal tar or asphalt without filler or with only a slight amount of filler. They shall be applied in the same manner as conventional coatings and shall be applied at a coverage that will result in the dry film thickness specified. The expected range of dry film thickness for these thin film bituminous coatings is from 1.7 to 3.0 mils (40 to 75 micrometers). Unless otherwise specified, the necessary number of coats shall be applied to provide a total minimum dry film thickness of 5 mils (125 micrometers).

**11.4.2 Cold-applied bituminous coating (medium film):** The term cold-applied bituminous coating (medium film) refers to high consistency filled solutions of coal tar or asphalt. They shall be applied by brushing or spraying. If spray applied, special heavy-duty pump type spray equipment shall be used. This material should be stirred without thinning until it attains proper consistency for application. It shall be applied at a coverage that will result in the dry film thickness specified or, if not specified, the dry film thickness as recommended by the manufacturer. The expected range of dry film thickness for the cold-applied bituminous coating (medium film) is from 5 to 10 mils (125 to 250 micrometers) per coat and unless otherwise specified, the necessary number of coats shall be applied to provide a minimum dry film thickness of 12 mils (300 micrometers).

**11.4.3 Cold-applied bituminous coating (thick film):** The term cold-applied bituminous coating (thick film) refers to very high consistency filled solutions of coal tar or asphalt. They shall be applied by brushing or spraying. If spray applied, special heavy-duty pump type spray equipment shall be used. These materials must be stirred without thinning until they attain the proper consistency for application. They shall be applied at a coverage that will result in the dry film thickness specified or, if not specified, the dry film thickness as recommended by the manufacturer. The expected range of dry film thickness for the cold-applied bituminous coating (thick film) is from 15 to 18 mils (380 to 460 micrometers) per coat and unless otherwise specified the necessary number of coats shall be applied to provide a minimum dry film thickness of 25 mils (635 micrometers).

**11.4.4 Cold-applied bituminous mastic (extra-thick film)**: The term cold-applied bituminous mastic (extra-thick film) refers to very thickly applied filled solutions of coal tar or asphalt applied by brushing, troweling, or spraying. If spray applied, special heavy-duty pump type spray equipment shall be used. Thinning should not be necessary and shall not take the place of adequate stirring. They shall be applied at a coverage that will result in the dry film thickness specified or, if not specified, the dry film thickness as recommended by the manufacturer. The expected range of dry film thickness for the cold-applied bituminous mastic (extra-thick film) is about 35 to 65 mils (890-1650 micrometers) per coat and it is preferable that it be applied in two coats. For additional information, refer to Paints 12, 32, and 33. A minimum total dry film thickness of 70 mils (1780 micrometers) is suggested.

**11.4.5 Bituminous emulsion**: The term "bituminous emulsion" refers to high consistency filled emulsions of coal tar or asphalt and water. Since they are compounded with water they must not be permitted to freeze at any time before drying. These emulsions shall be applied by brushing, spraying, or troweling. If spray applied, special heavy-duty pump type spray equipment shall be used. Thinning should not be necessary and shall not take the place of adequate stirring. They shall be applied at a coverage that will result in the dry film thickness specified or, if not specified, the dry film thickness as recommended by the manufacturer. The expected range of dry film thickness for the bituminous emulsion is from 8 to 15 mils (200 to 380 micrometers) per coat and unless otherwise specified the necessary number of coats shall be applied to provide a minimum dry film thickness of 20 mils (500 micrometers).

**11.4.6 Coal tar primer and enamel:** Coal tar primer and enamel for the interior and exterior of steel pipe, tanks and hydraulic structures shall be applied in accordance with the requirements of American Water Works Association (AWWA) specification C-203 unless otherwise specified. This specification is not intended to cover application of coal tar primers and enamel to steel structures of oil and gas pipelines when a low penetration enamel is considered desirable. Such application shall be done in accordance with specifications of the purchaser.

**11.5 EPOXY AND COAL TAR EPOXY COATINGS:** Two-package chemically cured epoxy and coal tar epoxy

Provided by : www.spic.ir Licensee: NISOC Library

coatings shall be stored, mixed, thinned, applied, and cured in accordance with the manufacturer's instructions and with the provisions of Sections 5.4.11 and 6. Also, any special precautions and instructions by the manufacturer shall be followed. Chemically cured coatings shall not be applied when the surface, coating, or air temperature is below the manufacturer's published minimum recommendation. When coatings formulated for low temperature application are applied at temperatures below 40 °F (4° C), it shall be verified that the surface is free of moisture (unless formulation permits it) and ice at the time of application.

**11.6 ZINC-RICH COATINGS:** For additional information refer also to SSPC Paint 20, "Zinc-Rich Primers" and PS Guide 12.00, "Guide to Zinc-Rich Coating Systems."

**11.6.1 Inorganic zinc-rich:** Inorganic zinc-rich coatings shall be applied by spray. Application by brush shall be limited to small areas and touch-up work. If the zinc powder is packaged separately, mix with the vehicle just before use. Inorganic zincs shall be thinned as recommended by the manufacturer. The coatings shall be applied to a dry film thickness between 2 to 4 mils (50 and 100 micrometers), unless otherwise stated in the specification or manu-facturer's written instructions. When applying by spray, the zinc dust shall be kept in suspension by use of a mechanical agitator for both airless and air atomized (conventional) spray. The vessel containing the coating and the spray gun shall be kept at approximately the same elevation (e.g., within 3 feet [1 meter]) while spraying. Prior to topcoating, a barrier or tie coat may be required for overcoating with certain generic coatings. The manufacturer's recommendations shall be followed. Sufficient curing of the zinc-rich primer is necessary before topcoating. The coating manufacturer may require a minimum relative humidity to ensure curing. Dry spray of the zinc-rich primer will result in improper adhesion of the topcoat. Dry spray shall be removed with a stiff bristle brush or wire screen without polishing the surface of the coating.

**11.6.2 Organic zinc-rich:** Most of the provisions of Section 11.6.1 are also applicable for the application of organic zinc-rich coatings except that they may also be applied by brush or roller when permitted by the manufacturer's written recommendations.

**11.7 URETHANE COATINGS:** For additional information, refer also to PS Guide 17.00, "Guide for Selecting Urethane Coating Systems."

**11.7.1** Single component moisture cured urethane coatings which meet ASTM D 16, Type II may be applied by brush, roller, conventional spray, and airless spray. Special care shall be taken to ensure that all spray equipment is moisture free. Since these coatings cure by reaction with moisture in the air, it should be noted that application on days when the humidity is low will result in slow cure. The manufacturer's directions shall be followed concerning thinning and application parameters. Type II urethane coatings shall be mixed by a mechanical mixer prior to application. This shall be done slowly so as not to create a vortex and introduce moisture into the coating which could reduce the pot life.

**11.7.2** Two component polyisocyanate polyol-cured urethane coatings may be applied by brush, roller, conventional spray, airless spray, or plural-component spray. Special care shall be taken to insure that all spray equipment is moisture free. The manufacturer's directions shall be followed concerning thinning and application parameters. The two components (isocyanate and polyol) shall be mixed as specified by the manufacturer. Mixing shall be done slowly so as not to create a vortex and introduce moisture into the coating which could reduce the pot life. These urethane coatings are extremely susceptible to moisture contamination and shall not be applied unless temperatures, both during application and up to three hours after application, will be at least 5 F° (3 C°) above the dew point.

**11.8 WATERBORNE THERMOPLASTIC COATINGS**

**11.8.1** Waterborne thermoplastic coatings (commonly called "latex coatings") may be applied by spray, brush, or roller. Cross brushing or cross spraying application is highly desirable. Application by spray tends to provide the best leveling. Conventional or airless spray can be used with most latex coatings. Since one-coat systems have very limited protective properties, multiple-coat systems shall always be applied. On structural steel, the preferred system is two coats of primer and one or more topcoats to achieve the specified dry film thickness. Where the dry film thickness is not specified, apply each coat at a minimum dry film thickness of 2.5 mils (64 micrometers) to achieve a total dry film thickness of 7.5 mils (190 micrometers). For additional information, refer to SSPC Paints 23 and 24.

**11.8.2** The atmospheric conditions at the time the latex coating, especially the primer, is applied are extremely important. A latex primer shall not be applied at a temperature below 50 °F (10 °C) or above 120 °F (50 °C) or when curing (coalescence) is expected outside this range. It should be noted that some waterborne thermoplastic coatings are formulated for application at temperatures below 50 °F (10 °C). High humidities (e.g., 80%) will slow the drying of these coatings (see Sections 6.2 and 6.3).

**11.8.3** The best conditions for storage of latex coatings are at temperatures between 40 °F (4 °C), and 80 °F (27 °C).

## 12. Curing and Handling of Coatings

**12.1 DRYING OF COATINGS**

**12.1.1** The minimum and maximum curing times before overcoating an existing coat of coating shall conform to the primer and overcoat manufacturer's written recoat instructions. If the maximum time is exceeded, the cured coating

Provided by : www.spic.ir Licensee: NISOC Library

shall be roughened or otherwise treated as recommended by the manufacturer of the overcoat before applying another coat.

**12.1.2** No coating shall be force dried under conditions which will cause checking, wrinkling, blistering, formation of pores, or detrimentally affect the protective properties of the coating. Always check with the coating manufacturer before force drying a coating.

**12.1.3** Coating shall be protected from rain, condensation, contamination, snow, and freezing until sufficiently cured for exterior exposure.

**12.1.4** No coating shall be subjected to immersion before it is thoroughly dried or cured in accordance with the manufacturer's written instructions.

**12.2 HANDLING OF COATED STEEL**

**12.2.1** Coated steel shall not be handled, loaded for shipment, or shipped until the coating has dried except as necessary in turning for coating or stacking for drying.

**12.2.2** Coating which is damaged in handling shall be removed and touched up with the same number of coats and kinds of coatings as were previously applied to the steel or as specified by the procurement documents.

## 13. Inspection

**13.1** All work and materials supplied under this specification shall be subject to timely inspection as required by the specification. The contractor shall correct such work or replace such material as is found deficient under the 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 procedure specified by the American Arbitration Association is recommended.

**13.2** Samples of coatings used under this specification shall be supplied upon request along with the supplier's name and identification for the materials.

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

## 14. Safety and Environmental Concerns

**14.1** All safety and environmental requirements stated in this specification and its component parts apply in addition to any applicable federal, state, and local rules and requirements. They also shall be in accord with instructions of the coating manufacturer and requirements of insurance underwriters.

**14.2** Coatings may be hazardous because of their flammability or toxicity. Proper safety precautions shall be observed to protect against these recognized hazards. Safe handling practices are required and should include, but not be limited to, the provisions of PA Guide 3, "A Guide to Safety in Coating Application."

**14.3** Some coatings specified herein may not comply with some air quality regulations because of their organic solvent content.

**14.4 MATERIAL SAFETY DATA SHEETS (MSDSs):** Information pertaining to the safe handling, application, and disposal of coatings can be obtained from their MSDSs, which are supplied by the manufacturers. The MSDSs for all materials shall accompany them wherever they are stored or used.

## 15. Disclaimer

While every precaution is taken to ensure that all information furnished in SSPC specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified therein, or of the specification itself.

## 16. Notes

Notes are not requirements of this specification.

**16.1** It is recommended that coating be stored in a warm building during very cold weather so that it is not necessary to thin the coating excessively for application since excessive thinning will result in a low solids content, and the dry film thickness will be below that intended for the particular material. It is advantageous to the contractor that this material be kept warm or heated prior to use, inasmuch as less material will be required, application will be easier, and the resulting film will meet the intent of the specification. When warming coatings, their temperature should not be permitted to exceed 100 °F (38 °C) unless special coating heating equipment is used. When the coating (or thinner) has a flash point below 100 °F (38 °C) it should not be heated above its flash point if it is heated in an open container.

**16.2** As much care as deemed practical should be exercised to prevent contamination of coated surfaces with particulate materials, soluble salts, and other foreign matter before overcoating. Thus, overcoating should be accomplished as soon as possible after curing requirements of undercoats are met. When intercoat contamination occurs before overcoating, the surface shall be washed with water and detergent or other approved material to remove as many contaminants as possible.

**16.3** A number of instruments are available that measure temperature with great accuracy. Some are described in The Inspection of Coatings and Linings (SSPC 97-07). Also refer to Volume 1 of the SSPC Painting Manual.

**16.4** Cold weather, high humidity, water, fog and mist, and rain during coating application, drying, or curing are detrimental to the performance of most coatings. It is

Provided by : www.spic.ir Licensee: NISOC Library

impossible to set down specific rules which govern the limits in which the coating application should be done since the variation from one coating to another may be large. Generally speaking, application should be done only under conditions which are conducive to quick evaporation of water. This generally means that the relative humidity should be low. Steel should not be coated when it is below the dew point since condensation of water on the steel will result. The only exception is for coatings to be applied that are formulated to tolerate moisture or liquid water on the surface.

Coatings which dry solely by evaporation of organic solvent are not believed to be harmed by application to steel which is below 32 °F (0 °C); however, under such conditions, the danger always exists that there will be a layer of ice on the surface of the steel. This same condition may prevail for application of conventional, air-oxidizing coatings. When the humidity is low and the steel is thoroughly dry beyond question, it is believed that coatings may be applied, provided the coating is of a type which will not be injured or whose drying will not be impaired by low temperature or low humidity.

Generally speaking, coatings should not be applied in weather which will subject them to damage, nor should they be applied when it is expected that the temperature will vary either below or above the temperature range recommended in writing by the manufacturer or drop to freezing before they have cured.

The dew point (see Section 6.2) is the temperature below which moisture from the air will begin to condense. If the surface temperature of the substrate is at or below the dew point, moisture will condense on it. It may be determined with a sling psychrometer, or other instrument, usually requiring determination of wet and dry bulb temperatures (ASTM E 337, "Relative Humidity by Wet- and Dry-Bulb Psychrometer"). Hand-held, digital moisture meters, hygrometers, etc., can make measurement of relative humidity and dew point simple and instantaneous. These electronic instruments can also provide simple measurement of relative humidity and dew point of a surface that is at a different temperature than ambient conditions.

In practice, the dew point requirement can be presumed to be satisfied if a thin, clearly defined film of water applied to the cleaned surface with a damp cloth evaporates within 15 minutes.

Low temperatures greatly reduce the curing rates of chemically cured coatings (certain epoxies, urethanes, inorganic zinc-rich coatings, coal tar epoxies, etc.). Unless otherwise permitted, chemically cured coatings should not be applied when the surface, coating, or ambient temperature is outside the range recommended by the coating manufacturer's written instructions.

**16.5** Coatings on structural steel are generally applied by brush or by spray. Either method is satisfactory if properly performed and the coating is formulated for the application method being used. The variations are slight, and often overshadowed by variations in workmanship.

Brushing of primers has the advantage of working coating into cracks and crevices and other surface irregularities. It may create brush marks, however, with coatings having limited leveling. Lacquer type coatings, such as vinyls, may be applied by brush with considerable difficulty only; the priming coat brushes on with least difficulty and results in better adhesion to the surface than spraying. Finish coats of lacquer type coating tend to lift underlying coats by solvent action and brushing combined; for this reason such finish coatings are best applied by spraying.

With many types of coatings, properly used high pressure spray methods can result in a thicker, more impermeable film. Spray operators must be properly selected and trained. Careful supervision and inspection are necessary with the various spray application methods to insure against such difficulties as dirty surfaces, dry spray, pinholes, holidays, missed areas, blind spots, contamination of coating or air, wind loss, or excessive outdoor overspray.

Several advantages are possible with the various high pressure airless methods of coating application, both hot and cold spray. These include labor savings as a result of fast application and a greater thickness per coat. Additional savings also can be traced to less flowback, less overspray, power (compressor) savings, use of higher solids in coating formulations, and less sensitivity to changes in ambient temperature during application.

**16.6** With roller application of coating on structural steel, high production rates approaching that of conventional spraying may be possible. The method works best on large smooth areas such as tanks or walls. Difficulties may be encountered when coating welds, rough spots, pits, rivet heads, edges, corners, etc., to ensure that adequate coating is applied. Supplementary brush coating is mandatory for those areas on structural steel, even though special rollers for these areas are available for general work. The requirements are generally the same as for brush and spray coating. Excellent results have been achieved, and it is possible to build up specified film thicknesses by this method. Roller coating is particularly useful where spraying cannot be undertaken due to the hazards from overspray or the flammability of solvent.

**16.7** Selection for the type of shop primer to be used should take into consideration the length of time anticipated between the shop applied coat and the first coat applied in the field. The period before a shop coat is to be topcoated in the field can vary from the construction schedule. Long periods of field exposure may degrade the shop coating so that it may have to receive periodic maintenance to continue to protect the steel from corrosion and be in a suitable condition for overcoating.

When longer periods of exposure are anticipated, special consideration should be given to surface preparation,

Provided by : www.spic.ir Licensee: NISOC Library

coating selection, film thickness, and to early application of a second primer/overcoat. Between shop priming and field coating, structural steel is often exposed to the most severe environments it will ever encounter and at a time when it is protected by only one coat of primer. The prime coat of coating is usually formulated to provide short-term protection and a good bond between the steel substrate and subsequent coats. Many shop-applied primers are not intended to provide long-term protection of the steel, particularly during exposure to dampness, bad weather, and industrial fumes.

**16.8** For high-performance coating service, special weld surfacing may be required to provide suitable surface conditions for the coating system specified. NACE RP0178 provides one method of specifying weld surfacing requirements, as well as other design and fabrication requirements for improving coating serviceability. Other methods of specifying and accepting weld surfacing conditions are employed in various industries. The weld surfacing requirements should generally be placed in the project specifications so that the painting contractor will not have to perform welding or grinding to provide the specified final surface conditions.

**16.9** In maintenance coating it is not ordinarily intended that sound, adherent, old coating be removed unless it is excessively thick or brittle or is incompatible with the new coating. It is essential, however, that the removal of deteriorated coating be carried back around the edges of the spot or area until an area of completely intact and adherent coating film, with no rust or blisters underneath, is attained. Edges of tightly adherent coating remaining around the area to be recoated must be feathered so that the recoated surface can have a smooth appearance to provide a transition from the area of repair to the intact coating. The remaining old coating should have sufficient adhesion so that it cannot be lifted as a layer by inserting the blade of a dull putty knife under it using moderate pressure.

Unless experience or spot tests have shown otherwise, it is usually preferable to use the same generic type of coating in recoating as in the original coating. If the new coating curls or lifts after application to an existing coating, the cleaning and application procedures should be reviewed to determine if good coating practices have been followed. If the new coating is found to be incompatible with the previous coating system, either the primer should be replaced with one more compatible, or the old coating should be completely removed before application of a new system.

Coating records should be kept by the owner for the purpose of determining information on the durability of coatings and the economic protection afforded by them. Refer to Volume 1 of the SSPC Painting Manual for additional information and a suggested record form.

## APPENDIX A - ADDITIONAL REFERENCE MATERIALS

The standards, reports, and publications listed below are not required as part of the specification but are recommended resources (note that the standards listed in Section 3 are required parts of this specification).

**SSPC PUBLICATIONS AND STANDARDS:**

| | |
|---|---|
| **AB 1** | Mineral and Slag Abrasives |
| **AB 2** | Cleanliness of Recycled Ferrous Metallic Abrasives |
| **AB 3** | Newly Manufactured or Re-Manufactured Steel Abrasives |
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA Guide 4** | Guide to Maintenance Recoating with Oil Base or Alkyd Coating Systems |
| **PA Guide 5** | Guide to Maintenance Coating Programs |
| **Guide 6** | Guide for Containing Debris Generated During Paint Removal Operations |
| **Guide 7** | Guide for the Disposal of Lead-Contaminated Surface Preparation Debris |
| **Guide 8** | Guide to Topcoating Zinc-Rich Primers |
| **Guide 11** | Guide for Coating Concrete |
| **Guide 12** | Guide of the Illumination of Industrial Painting Products |
| **ME 1** | Test Panel Preparation Method No. 1, Uncontaminated Rusted Steel |
| **Paint 15** | Steel Joist Shop Primer |
| **Paint 20** | Zinc Rich Primers (Type I - “Inorganic” and Type II - “Organic”) |
| **Paint 23** | Latex Primer for Steel Surfaces |
| **Paint 24** | Latex Semi-Gloss Exterior Topcoat |
| **Paint 25** | Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel |
| **Paint 25 BCS** | Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Blast Cleaned Steel |
| **Paint 32** | Coal Tar Emulsion Coating |
| **Paint 33** | Coal Tar Mastic - Cold-Applied |
| **Paint 34** | Water-Borne Epoxy Topcoat for Steel Structures |
| **Paint 35** | Medium Oil Alkyd Primer (Air Dry/ Low Bake) |
| **PS Guide 17.00** | Guide for Selecting Urethane Painting Systems |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **PS Guide 12.00** | Guide to Zinc-Rich Coating Systems |
| **QP 1** | Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures) |
| **QP 3** | Standard Procedure for Evaluating Qualifications of Shop Painting Contractors |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |
| **SP 11** | Power Tool Cleaning to Bare Metal |
| **SP 12/NACE No. 5** | Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating |
| **SP 13/NACE No. 6** | Surface Preparation of Concrete |
| **SP 14/NACE No. 8** | Industrial Blast Cleaning |
| **TR 2/NACE 6G198** | Joint Technical Report, Wet Abrasive Blast Cleaning |
| **TU 1** | Surface-Tolerant Coatings for Steel |
| **TU 2** | Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment Facilities |
| **TU 3** | Technology Update on Overcoating |
| **TU 4** | Field Methods for Retrieval and Analysis of Soluble Salts on Substrates |
| **VIS 1-89** | Visual Standard for the Inspection of Blast Cleaned Steel |
| **VIS 3** | Visual Standard for Power and Hand-Tool Cleaned Steel |
| **VIS 4(I) /NACE No. 7** | Visual Reference Photographs for Steel Cleaned by High Pressure Water Jetting |
| **SSPC 97-07** | The Inspection of Coatings and Linings |

**ASTM STANDARD:**

| | |
|---|---|
| **E 337** | Test Method for Measuring Humidity with a Psychrometer (The Measurement of Wet- and Dry-Bulb Temperatures) |

**AMERICAN WATER WORKS ASSOCIATION (AWWA) STANDARD:**

| | |
|---|---|
| **C 203** | Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied |

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT APPLICATION STANDARD NO. 2

## Measurement of Dry Coating Thickness With Magnetic Gages

## 1. Scope

**1.1 GENERAL:** This standard describes the procedures to measure the thickness of a dry film of a nonmagnetic coating applied on a magnetic substrate using commercially available magnetic gages. These procedures are intended to supplement manufacturers' instructions for the manual operation of the gages and are not intended to replace them.

**1.2** The procedures for calibration and measurement are described for two types of gages: pull-off gages (Type 1) and constant pressure probe gages (Type 2).

**1.3** The standard defines a procedure to determine if the film thickness over an extended area conforms to the minimum and the maximum levels specified.

## 2. Description and Use

**2.1 DEFINITIONS:**

**2.1.1 Gage Reading:** A single reading at one point.

**2.1.2 Spot Measurement:** The average of at least three gage readings made within a 1.5 inch (4 cm) diameter circle.

**2.2 DESCRIPTION OF GAGES:**

**2.2.1 Gage Types:** The gage type is determined by the specific magnetic properties employed in measuring the thickness and is not determined by the mode of data readout, i.e., digital or analog. This standard does not cover gages that measure the effect of eddy currents produced in the substrate.

**2.2.2 Type 1—Pull-Off Gages:** In pull-off gages, a permanent magnet is brought into direct contact with the coated surface and a calibrated scale measures the force necessary to pull the magnet from the surface. Less force is required to remove the magnet from a thick coating. The scale is nonlinear.

- **Type 1A** - A magnet is attached to one end of a pivoting balance arm. This assembly is connected to a calibrated helical spring. By rotating a dial, the spring increases the force on the magnet and pulls it from the surface. The Type 1A gages are commonly called "banana" gages.
- **Type 1B** - A magnet is mounted directly or indirectly to a coil spring. The spring acts perpendicularly to the surface to pull off the magnet. The Type 1B gages are commonly called "pencil" gages.

**2.2.3 Type 2—Constant Pressure Probe Gages:** A constant pressure probe gage uses a probe which exerts a constant a coil spring. The spring acts perpendicularly to the surface to pull off the magnet. The Type 1B gages are commonly called "pencil" gages.

**2.2.3 Type 2—Constant Pressure Probe Gages:** A constant pressure probe gage uses a probe which exerts a constant pressure on the coated surface during the entire measuring operation. Electronic circuitry is used to convert a reference signal into coating thickness. (See 8.1.)

**2.3 USE OF STANDARD:** This document contains the following:

- Calibration, verification and measurement procedures (Section 4).
- Required number of measurements for conformance to a thickness specification (Section 5).
- Notes on gage principles and various factors affecting thickness measurement (Section 8).
- A numerical example of thickness measurement over an extended area (Appendix 1).
- A numerical example of verification of the calibration of Type 2 gages using plastic shims (Appendix 2).

## 3. Reference Standards

**3.1** The documents and standards referenced in this standard are listed in Section 3.4 and form a part of this standard.

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

**3.3** If there is a conflict between the requirements of any of the cited documents and this standard, the requirements of this standard shall prevail.

**3.4 NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) STANDARD REFERENCE MATERIALS.** (See Section 8.15.)

Provided by : www.spic.ir Licensee: NISOC Library

## 4. Calibration, Verification and Measurement Procedures

### 4.1 GENERAL

**4.1.1 Access to Bare Substrate:** All gages are affected to some degree by substrate conditions such as roughness, shape, thickness and composition. To correct for this effect, access to the uncoated substrate is recommended. Another option is to use separate uncoated reference panels with similar roughness, shape, thickness and composition. (See Sections 8.3 to 8.9.) These would be used as the bare substrate in the procedures of Sections 4.2 and 4.3. Reference panels shall be of sufficient size to preclude edge effects. (See Section 8.7.)

Measurements on the bare substrate can be taken before areas during painting. If the coating has already been applied to the entire surface, small areas of coating may be removed and later patched. Do not allow the removal process to alter the condition of the substrate. Paint strippers should be used in order to retain the profile.

**4.1.2 Spot Measurement:** Repeated gage readings, even at points close together, may differ due to small surface irregularities of the coating and the substrate. Therefore, a minimum of three (3) gage readings shall be made for each spot measurement of either the substrate or the coating. For each new gage reading, move the probe to a new location within the 1.5 inch (4 cm) diameter circle defining the spot. Discard any unusually high or low gage reading that cannot be repeated consistently. Take the average of the acceptable gage readings as the spot measurement.

### 4.2 CALIBRATION, VERIFICATION AND MEASUREMENT: TYPE 1—PULL-OFF GAGES

**4.2.1** For Type 1 gages, use test blocks bearing calibrated nonmagnetic coatings that are traceable to a suitable national standard. (See Section 8.15.) The standards must be large enough to exceed the critical mass of steel needed to satisfy the magnetic field of the Type 1 (pull-off) magnets. Shims of plastic or of non magnetic metals which are acceptable for calibration of Type 2 (constant pressure probe) gages should not be used for calibration of the Type 1 gages. (See Section 8.1.1.) If the manufacturer's instructions are in conflict with this standard by allowing the use of plastic or other nonmagnetic shims for the calibration of a Type 1 gage, the contracting parties must both be notified of this fact and agree on a method of calibration.

If proprietary thickness standards are to be used, agreement between contracting parties should be reached prior to starting the job.

**4.2.2** Using the Type 1 (pull-off) gage, measure the thickness of a series of calibration standards covering the expected range of coating thickness. To guard against measuring with an inaccurate gage, recheck the gage at the beginning and the end of each work shift with one or more of the standards. During the work shift, if the gage is dropped or suspected of giving erroneous readings, its calibration should be rechecked. If deemed appropriate by the contracting parties, initial agreement can be reached on the details and frequency of verification or calibration. Record the calibration data and the method used to verify the calibration. If the gage is found to be out of calibration at the end of the work shift, all measurements made since the last calibration are suspect.

**4.2.3** When the gage no longer agrees with the standard, check the probe for cleanliness. If dirty, clean as described in Section 8.5.1. If the gage still does not agree with the standard, the gage is in need of repair or replacement. Some gages can be adjusted to read accurately in a given range. Adjust the gage to read correctly on a given standard. Then check the gage on nonlinear scales and any adjusting feature is linear in nature. Therefore, only a given segment of the scale can be accurate after adjustment.

**4.2.4** Measure the bare substrate at a number of spots to obtain a representative average value. This average value is the base metal reading (BMR). Note the gage is not to be calibrated on the bare substrate.

**4.2.5** Measure the dry coating at the number of spots specified in Section 5.

**4.2.6** Subtract the base metal reading from the gage reading to obtain the thickness of the coating.

### 4.3 CALIBRATION, VERIFICATION AND MEASUREMENT: TYPE 2—CONSTANT PRESSURE PROBE GAGES

**4.3.1** Different manufacturers of Type 2 (constant pressure probe) gages follow different methods of calibration or adjustment. Calibrate the gage according to manufacturer's instructions.

**4.3.2** With a properly calibrated gage, measure the dry coating as specified. (See Section 4.1.2.)

**4.3.3** Verify the calibration of the gage at the beginning and the end of each work shift with one or more of the standards. (See Appendix 2). During the work shift, if the gage is dropped or suspected of giving erroneous readings, its calibration should be rechecked. If deemed appropriate by the contracting parties, initial agreement can be reached on the details and frequency of verification or calibration. Record the calibration data and the method used to verify the calibration. If the gage is found to be out of calibration at the end of the works shift, all measurements made since the last calibration are suspect.

Provided by : www.spic.ir Licensee: NISOC Library

## 5. Required Number of Measurements for Conformance to a Thickness Specification

**5.1 NUMBER OF MEASUREMENTS:** Make five (5) separate spot measurements (average of the gage readings, see Section 4.1.2) spaced randomly over each 10 $m^2$ (100 $ft^2$) area to be measured. If the contracting parties agree, more than five (5) spot measurements may be taken in a given area. (See Section 5.3.) The five spot measurements shall be made for each 10 $m^2$ (100 $ft^2$) of area as follows:

**5.1.1** For structures not exceeding 30 $m^2$ (300 $ft^2$) in area, each 10 $m^2$ (100 $ft^2$) area shall be measured.

**5.1.2** For structures not exceeding 100 $m^2$ (1,000 $ft^2$) in area, three 10 $m^2$ (100 $ft^2$) areas shall be randomly selected and measured.

**5.1.3** For structures exceeding 100 $m^2$ (1,000 $ft^2$) in area, the first 100 $m^2$ (1,000 $ft^2$) shall be measured as stated in Section 5.1.2 and for each additional 100 $m^2$ (1,000 $ft^2$) of area or increment thereof, one 10 $m^2$ (100 $ft^2$) area shall be randomly selected and measured.

**5.1.4** If the dry film thickness for any 10 $m^2$ (100 $ft^2$) area (see Sections 5.1.2 and 5.1.3) is not in compliance with the requirements of Sections 5.2.1 and 5.2.2, then additional measurements must be made to isolate the nonconforming area.

**5.2 SPECIFYING THICKNESS:** Both a maximum and a minimum thickness should be specified for the coating. If a maximum thickness value is not explicitly specified, the specified thickness shall be the minimum.

**5.2.1 Minimum Thickness:** The average of the spot measurements for each 10 $m^2$ (100 $ft^2$) area shall not be less than the specified minimum thickness. No single spot measurement in any 10 $m^2$ (100 $ft^2$) area shall be less than 80% of the specified minimum thickness. Any gage reading may under-run by a greater amount. If the average of the spot measurements for a given 10 $m^2$ (100 $ft^2$) area meets or exceeds the specified minimum thickness, but one or more spot measurements is less than 80% of the specified minimum thickness, additional measurements may be made to define the nonconforming area. (See Appendix 1.)

**5.2.2 Maximum Thickness:** The average of the spot measurements for each 10 $m^2$ (100 $ft^2$) area shall not be more than the specified maximum thickness. No single spot measurement in any 10 $m^2$ (100 $ft^2$) area shall be more than 120% of the specified maximum thickness. Any gage reading may overrun by a greater amount. If the average of the spot measurements for a given 10 $m^2$ (100 $ft^2$) area meets or falls below the specified maximum thickness , but one or more spot measurements is more than 120% of the specified maximum thickness, additional measurements may be made to define the nonconforming area. Manufacturers' literature may be consulted to determine if higher maximum thickness readings are allowable under specific circumstances.

**5.3** Other size areas or number of spot measurements may be specified in the procurement documents as appropriate for the size and shape of the structure to be measured.

## 6. Accuracy

**6.1** To qualify under this standard, a gage must have an accuracy at least within ±10%. For thicknesses less than 25 μm (1 mil), the gage must have an accuracy at least within ±2.5 μm (0.1 mil).

## 7. Disclaimer

**7.1** While every precaution is taken to insure that all information furnished in SSPC standards and specifications is as accurate, complete and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings or methods specified therein, or of the specification or standard itself.

## 8. Notes

Notes are not a requirement of this standard.

**8.1 PRINCIPLES OF THE MAGNETIC GAGE:** Each of these gages can sense and indicate only the distance between the magnetic surface of the steel and the small rounded tip of the magnet or probe that rests on the top surface of the coating. This measured distance, from the top surface of the coating, must be corrected for the thickness of any extraneous films or other interfering conditions on the surface of the steel. Such correction is described in Section 4.2 for Type 1 gages and manufacturer's instructions for Type 2 gages.

**8.1.1** Type 1 (pull-off) gages use a calibrated spring mechanism to measure the force needed to pull a small permanent magnet from the surface of the coated steel. The magnetic force holding the magnet to the surface varies inversely as a nonlinear function of the distance between magnet and steel, i.e., the thickness of the dry coating (plus any other films present).

The Type 1A "banana" gages use a helical spring to pull a small permanent magnet from the surface. Internal balancing mechanisms in most banana gages compensate for horizontal, vertical and overhead positions so that there is no need to recalibrate when changing orientation.

In a Type 1B "pencil" gage, a calibrated coil spring measures the force necessary to pull the permanent magnet

Provided by : www.spic.ir Licensee: NISOC Library

from the surface. Because of gravitational effects, these gages must be recalibrated when the orientation of the surface changes; e.g., a gage calibrated on a horizontal surface will not be accurate when measuring a vertical surface. Some gages have three separate indicators which compensate for horizontal, vertical and overhead positions. Type 1B gages are generally not as precise as Type 1A gages. Normally, Type 1 gages are not adjusted or reset for each new series of measurements.

Shims of sheet plastic or of nonmagnetic metals, which are permissible for calibrating Type 2, (constant pressure probe) gages, should not be used for calibration of Type 1 gages. Such shims are usually fairly rigid and curved and do not lie perfectly flat, even on a smooth steel test surface. Near the pull-off point of the calibration measurements with any Type 1 gage, the shim frequently springs back from the steel surface, raising the magnet too soon and causing erroneous calibration readings.

**8.1.2** Type 2 (constant pressure probe) gages operate on two different magnetic principles. Some Type 2 gages use a permanent magnet. When the magnet is brought near steel, the magnetic flux density within the magnet is increased. By measuring this change in flux density, which varies inversely to the distance between the magnet and the steel substrate, the coating thickness can be determined. Hall elements and magnet resistance elements are the most common ways to measure magnetic flux density. However, the response of these elements is temperature dependent, so temperature compensation is required.

Other Type 2 gages operate on the principle of electromagnetic AC current thereby producing a changing magnetic field at the probe. As with a permanent magnet, the magnetic flux density within the rod increases when the probe is brought near the steel substrate. This change is easy to detect by using a second coil. The output of the second coil is related to coating thickness and this relationship can be determined experimentally.

**8.2 REPEATABILITY:** Magnetic gages are necessarily sensitive to very small irregularities of the coating surface or of the steel surface directly below the probe center. Repeated gage readings on a rough surface, even at points very close together, frequently differ considerably, particularly for thin films over a rough surface with a high profile.

**8.3 ZERO SETTING:** Type 1 magnetic gages should not be adjusted or set at the scale zero (0) with the gage applied to either a rough or a smooth uncoated steel surface.

**8.4 ROUGHNESS OF THE STEEL SURFACE:** If the steel surface is smooth and even, its surface plane is the effective magnetic surface. If the steel is roughened, as by blast cleaning, the “apparent” or effective magnetic surface that the gage senses is an imaginary plane located between the peaks and valleys of the surface profile. With a correctly calibrated and adjusted Type 2 gage, the reading obtained indicates the coating thickness above this imaginary plane. (See Section 4.3.) If a Type 1 gage is used, the coating thickness is obtained by subtracting the base metal reading. (See Section 4.2.)

**8.5 DIRTY, TACKY OR SOFT FILMS:** The surface of the coating and the probe of the gage must be free from dust, grease and other foreign matter in order to obtain close contact of the probe with the coating and also to avoid adhesion of the magnet. The accuracy of the measurement will be affected if the coating is tacky or excessively soft. Tacky coating films also cause unwanted adhesion of the magnet. Unusually soft films may be dented by the pressure of the probe. Soft or tacky films can sometimes be measured satisfactorily by putting a shim on the film, measuring total thickness of coating plus shim and subtracting shim thickness.

**8.5.1** Ordinary dirt and grease can be removed from a probe by wiping with a soft cloth. Magnetic particles adhering to the probe can be removed using an adhesive backed tape. Any adhesive residue left on the probe must then be removed.

**8.6 ALLOY STEEL SUBSTRATES:** Differences among most mild low-carbon steels will not significantly effect magnetic gage readings. For higher alloy steels, the gage response should be checked. In any event, the gage should be recalibrated on the same steel over which the coating has been applied.

**8.7 PROXIMITY TO EDGES:** Magnetic gages are sensitive to geometrical discontinuities of the steel, such as holes, corners or edges. The sensitivity to edge effects and discontinuities varies from gage to gage. Measurements closer than 2.5 cm (1 in) from the discontinuity may not be valid unless the gage is calibrated specifically for that location.

**8.8 PROXIMITY TO OTHER MASS OF STEEL:** The older two-pole Type 2 gages with permanent magnets are sensitive to the presence of another mass of steel close to the body of the gage. This effect may extend as much as three inches (7.6 cm) from an inside angle.

**8.9 CURVATURE OF STEEL SURFACE:** Magnetic gage readings may be affected by surface curvature. If the curvature is appreciable, valid measurements may still be obtained by calibrating or adjusting the gage on a similarly curved surface.

**8.10 TILT OF PROBE:** All of the magnets or probes must be held perpendicular to the coated surface to produce valid measurements.

Provided by : www.spic.ir Licensee: NISOC Library

**8.11 OTHER MAGNETIC FIELDS:** Strong magnetic fields, such as those from welding equipment or nearby power lines, may interfere with operation of the gages. Also, residual magnetism in the steel substrate may affect gage readings. With fixed probe two-pole gages in such cases, it is recommended that the readings before and after reversing the pole positions be averaged. Other gages may require demagnetization of the steel.

**8.12 EXTREMES OF TEMPERATURE:** Most of the magnetic gages operate satisfactorily at 4°C and 49 °C (40 °F and 120 °F). Some gages function well at much higher temperatures. However, if such temperature extremes are met in the field, the gage might well be checked with at least one reference standard after both the standard and the gage are brought to the same ambient temperature. Most electronic gages compensate for temperature differences among the gage, probe and surface.

**8.13 VIBRATION:** The accuracy of the Type 1 (pull-off) gages is affected by traffic, machinery, concussions, etc. When these gages are set up for calibration or measurement of coating films, there should be no apparent vibration.

**8.14 VARIATION IN THICKNESS - 80% OF MINIMUM/ 120% OF MAXIMUM:** In any measurement there is a certain level of uncertainty. Two inspectors using the same gage will not necessarily record the exact same number for a given spot measurement using the same 4 cm (1.5 in) diameter circle. To allow for this natural fluctuation, an individual spot measurement is permitted to be below the specified minimum thickness as long as other spots in the 10 $m^2$ (100 $ft^2$) area are high enough to make the average thickness meet or exceed the specified minimum thickness. Similar reasoning applies to maximum thickness. The 80% of specified minimum and 120% of specified maximum allow for the tolerance of the gage and calibration standards and for variations in the substrate.

**8.15** Polished metal calibration standards are manufactured by the National Institute of Standards and Technology (NIST). The chrome plated panels are flat smooth steel 2.86 x 2.86 cm (1.125 x 1.125 in) in size. Examples of some NIST standards are:

**Certified Coating Thickness Calibration Standards**

Nonmagnetic Coating on Steel

| | | |
|---|---|---|
| **SRM 1358** | Set of 3 | 80, 225, 1000 µm (3, 9, 40 mil) |
| **SRM 1359** | Set of 4 | 48, 140, 505, 800 µm (2, 5.5, 20, 31 mil) |
| **SRM 1362a** | Set of 4 | 40, 80, 140, 205 µm (1.6, 3, 5.5, 8 mil) |
| **SRM 1331a to 1339a** | | Single standards from 3 µm (0.1 mil) to 62 µm (2.4 mil) |

**8.16 CORRECTING LOW OR HIGH THICKNESS:** The contracting parties should agree upon the method of correcting film thicknesses that are above the maximum or below the minimum specification. This method may be specified in the procurement documents, may follow manufacturer's instructions or may be a compromise reached after the nonconforming area is discovered.

## APPENDIX 1—Numerical Example of Average Thickness Measurement

The following numerical example is presented as an illustration of Section 5. (Reference JPCL, Vol 4, No 5, May 1987). Suppose this structure is 30 $m^2$ (300 $ft^2$) in area. Mentally divide the surface into three equal parts, each being about 10 $m^2$ (100 $ft^2$).

Part A - 10 $m^2$ (100 $ft^2$)
Part B - 10 $m^2$ (100 $ft^2$)
Part C - 10 $m^2$ (100 $ft^2$)

First, measure the coating thickness on Part A. This involves at least 15 readings of the thickness gage. (See Figure A1.) Assume the specification calls for 64 µm (2.5 mils) minimum thickness. The average thickness for area A is then the average of the five spot measurements made on area A, namely 66 µm (2.6 mils).

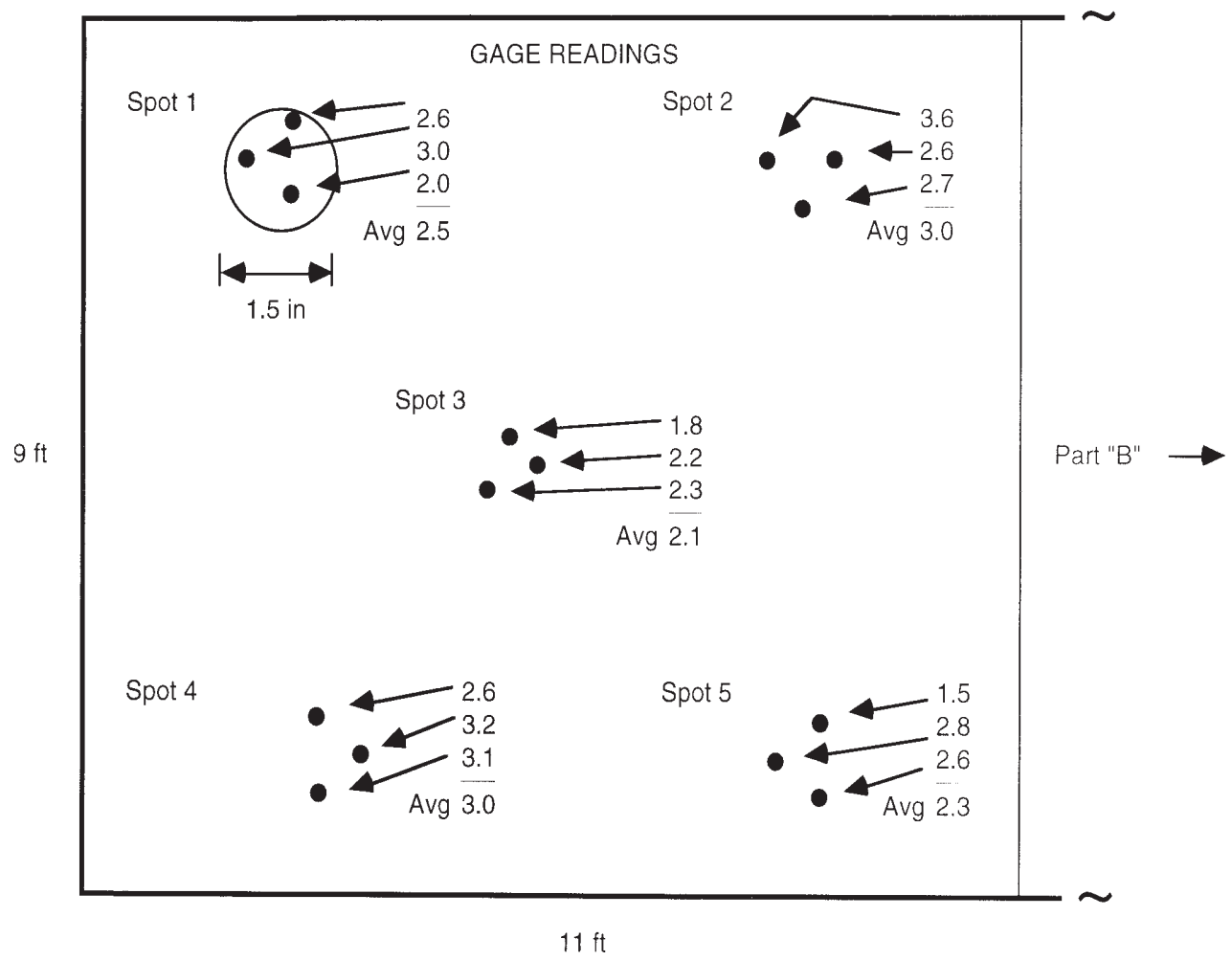
| | | |
|---|---|---|
| Spot 1 | 64 µm | 2.5 mils |
| Spot 2 | 76 | 3.0 |
| Spot 3 | 53 | 2.1 |
| Spot 4 | 76 | 3.0 |
| Spot 5 | 58 | 2.3 |
| Avg. | 66 µm | 2.6 mils |

The average, 66 µm, exceeds the specified minimum of 64 µm and thus satisfies the specification. However it must be decided if the lowest spot measurement, 53 µm, is within 80% of the specified minimum thickness. Eighty percent of 64 µm is 51 µm (0.80 x 64 = 51). Although 53 µm is below the specified minimum, it is still within 80 percent of it, so the specification is satisfied. [The average, 2.6 mils, exceeds the specified minimum of 2.5 mils and thus satisfies the specification. However it must be decided if the lowest spot measurement, 2.1 mils, is within 80% of the specified minimum thickness. Eighty percent of 2.5 mils is 2.0 mils (0.80 x 2.5 = 2.0). Although 2.1 mils is below the specified minimum, it is still within 80 percent of it, so the specification is satisfied.]

There are individual gage readings of 38 µm at spot 5 and 46 µm at spot 3, both of which are clearly less than 51 µm. This is allowed because only the average of the three readings (i.e., the spot measurement) must be greater than or equal to 51 µm. [There are individual gage readings of 1.5 mils at spot 5 and 1.8 mils at spot 3, both of which are clearly less than 2.0 mils. This is allowed because only the average of the three readings (i.e., the spot measurement) must be greater than or equal to 2.0 mils.]

Provided by : www.spic.ir Licensee: NISOC Library

**FIGURE A1**
**Part "A" of Structure (Area Approx. 10 m² [100 ft²])**




Since the structure used in this example is about 30 m² (300 ft²), the procedure used to measure the film thickness of part A must be applied to both part B and part C. The measured thickness of part B must exceed the 64 µm (2.5 mils) specified minimum as must the thickness of part C.

To monitor the thickness of this entire 30 m² (300 ft²) structure, at least 45 individual gage readings must be taken, from which 15 spot measurements are calculated. The five spot measurements from each 10 m² (100 ft²) part of the structure are used to calculate the thickness of that part.

## Appendix 2—Example of Verification of the Calibration of Type 2 Gages Using Plastic Shims

This example describes a method to check if a Type 2 gage is properly calibrated.

Suppose the coating thickness is specified at 100 µm (4.0 mils). The Type 2 constant pressure probe gage being used has been calibrated according to the manufacturer's recommendation. Now its calibration over blast cleaned steel must be verified. A test coupon which had been blast cleaned during the time the structure was blasted and has a profile representative of that under the coating is available. After selecting a 50 µm (2.0 mil) and a 250 µm (10.0 mil) plastic shim, proceed to take thickness readings of the shims lying on the bare blasted surface.

Because of the randomized nature of a blast cleaned surface, repeated readings may exhibit significant variation. Thus, make at least 10 measurements on each shim and record their averages. There is no need to keep track of each individual reading. Many gages will compute the average for you.

The thickness of a plastic shim is typically accurate to within ±5%. After calibration according to manufacturer's instructions, the gage is probably accurate to within ±5% also. Therefore, for the gage to be in agreement with the shim, the average thickness measured by the gage should be within ±10% of the shim's thickness. If the average thickness measured on the 51 µm (2.0 mil) shim is 56 µm (2.2 mils), the gage is in agreement with the shim because 56 is within ±10% of 51 (2.2 is within 10% of 2.0).

Provided by : www.spic.ir Licensee: NISOC Library

Similarly, if the average thickness of the 254 μm (10.0 mil) shim is measured to be 279 μm (11.0 mils), the gage calibration is verified because 279 is within ±10% of 254 (11.0 is within ±10% of 10.0).

In summary, if the average measurement of the 51 μm (2 mil) shim is between 46 and 56 μm (1.8 and 2.2 mils), and if the average measurement of the 254 μm (10.0 mil) shim is between 229 and 279 μm (9.0 and 11.0 mils), the calibration is verified.

Check that another shim of intermediate thickness, for example 127 μm (5.0 mils), is also within ±10%. If the calibration is verified on both the high and the low shims, it is almost always verified on the intermediate value shim.

NOTE: With some gages it may be more practical to adjust the gage at the intermediate thickness (e.g., 127 μm shim) first and then verify that the gage also reads the high and the low shims correctly.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT APPLICATION GUIDE NO. 3

## A Guide to Safety in Paint Application

### 1. Scope

**1.1** All necessary precautions should be taken to protect personnel and property from accidents due to falls, fumes, fire, explosion, or other dangers. Recommendations made herein are not all-inclusive and do not supplant or replace other measures covering unusual conditions. They are not intended to conflict with or supersede any federal, state, or local statute or regulation or the controls listed in Section 2.

**1.2** This guide defines methods and practices which are most practical in maintaining safety during application of protective coatings on steel structures. Complete coverage of all aspects is not presented. The objective of this guide is to itemize basic actions and care that should be considered while working in or on access facilities, using professional tools to apply materials having potential hazards.

**1.3** All personnel involved in the application of protective coatings should be aware constantly of the several hazards with regard to access facilities, specialized tools, and toxic or flammable materials. Many workers have some knowledge of one or two of these categories, but each should be advised of all precautions necessary and trained to prevent or eliminate dangerous conditions in all three areas.

**1.4** Areas not included herein which appear in other SSPC documents:

- safety in surface preparation;
- pretreatment methods;
- removal of existent coatings;
- specialized areas of coil and appliance ceramics, container high bake coatings, and powder coatings; and
- paint manufacturing plants.

### 2. Regulating Controls

**2.1** Federal laws should govern all works. Most of these are defined in the rulings of OSHA.

**2.2** State safety requirements should exert control in relevant areas whenever federal law does not cover projects.

**2.3** Municipal or township ordinances should be followed whenever specific rulings impose restrictions beyond the federal and state controls.

**2.4** Safety practice and rulings may come from area labor groups. Such should control actions for improved personnel relations.

**2.5** Some contract specifications may contain requiremeets for safe methods of practice for specific areas.

**2.6** Rules of safety by individual contractors should be adhered to since such are based on previous experiences.

**2.7** All safety instructions received from the paint manufacturer should be followed.

**2.8** Safe storage regulations should control all work regardless of source: civil law, contractor rule, labor rule, designer specifications.

### 3. References

**3.1** National Safety Council, 425 North Michigan Avenue, Chicago, IL 60611.

- Industrial Data Sheet No. 296, Bridge Painting
- Accident Prevention Manual for Industrial Operations, International Book Number 0 87912-024-X.
- Pamphlets, data sheets, instruction cards relevant to paint.

**3.2** Occupational Safety and Health Administration (OSHA) Standards, Superintendent of Documents; U.S. Government Printing Office, Washington DC 20402.

- 29 CFR 1910 Occupational Safety and Health Standards (General)
- 29 CFR 1910-94 Ventilation

**3.3** American National Standards Institute (ANSI), 14 Broadway, New York, NY 10018.

- ANSI A14.1 Safety Code for Wood Ladders
- ANSI A14.2 Safety Code for Metal Ladders
- ANSI Z87.1 Industrial Eye Protection
- ANSI Z88.2 Respiratory Protection
- ANSI Z9.3 Design, Construction, and Ventilation of Spray Finishing Operations

Provided by : www.spic.ir Licensee: NISOC Library

**3.4** Hazardous Substance Guide for Construction, Associated General Contractors of America, 1957 E. St., NW, Washington, DC, 20006-5199.

**3.5** National Fire Protection Association Guide on Hazardous Materials, P.O. Box 9101, Batterymarch Park, Quincy, MA 02269-9101.

**3.6** Chemical Manufacturers Association, Safety G SG10, 2501 M St. NW, Washington, DC 20037.

**3.7** Industrial Ventilation—A Manual of Recommended Practice, American Conference of Governmental Industrial Hygienists (ACGIH) 1980, 6500 Glenway Avenue, Bldg D-7, Cincinnati, OH 45211.

**3.8** International Brotherhood of Painters and Allied Trades, AFL-CIO "Play It Safe," United Unions Building, 1750 New York Avenue, NW, Washington, DC 20006.

**3.9** Threshold Limit Values for Chemical Substances in Workroom Air, Adopted by ACGIH, 6500 Glenway Avenue, Bldg. D-7, Cincinnati, OH 45211.

**3.10** Federal Specification BB-A-1034.

## 4. Definitions

**4.1** Personnel includes all people who may have reason to spend time on the jobsite. All classes of painters, helpers, foremen, inspectors, managers, and owners of items involved should be considered.

**4.2** Coating includes all liquid materials which may be applied to any surface for purposes of protection or decoration of that surface. Application may be with brush, roller, air gun, airless gun, trowel, and hand mitten.

**4.3** Solvents are those liquids which dissolve coatings and reduce their viscosity to that suitable for application. They have a wide range of both volatility and flammability and evaporate from the applied film to leave the solids base for protection and decoration of the substrate.

**4.4** Access means include all staging scaffolds, ladders, ropes, and other equipment to be used to place paint and painter in position for applications.

**4.5** Preventives include both equipment and actions which may in any way increase a margin of safety for all persons at the jobsite during any phase of the operation.

## 5. Coatings

**5.1 HANDLING COATING MATERIALS:** Coatings materials should be stored in safe, well ventilated areas where sparks, flames, and the direct rays of the sun can be avoided. Containers should be kept tightly sealed until ready for use. Warning tags should be placed on toxic materials.

Recommended safety rules for mixing operations include the following:

- Use eye protection (goggles, etc.).
- Use protective gloves.
- Keep the face and head away from the mixing container.
- Use protective face cream.
- Avoid splash and spillage, and inhalation of vapors.
- Mix all materials in well ventilated areas away from sparks and flames.
- Use low-speed mechanical mixers.
- Clean up spillage immediately.
- Avoid excessive temperatures.

Protective devices and equipment required for application of coatings materials are determined by the type of coating as well as by the environment. The coatings manufacturers should provide Material Safety Data Sheets on each product. Unless definite information regarding explosion and toxicity hazards inherent in the material are provided by the manufacturer, a written request for such data should be made before starting the coatings application. Records of previous applications using similar materials also should be examined.

**5.2 HEALTH HAZARDS OF COATING MATERIALS:** A coating material may be considered a health hazard when its properties are such that it can either directly or indirectly cause injury or incapacitation, either temporary or permanent, from exposure by contact, inhalation, or ingestion. (Refer to Threshold Limit Values for Chemical Substances in Workroom Air.)

Degrees of health hazard are ranked according to the probable severity of injury or incapacitation, as follows:

**5.2.1** Materials which, on very short exposure, could cause death or major residual injury even though prompt medical treatment was given. Types of these materials are:

- Materials which can penetrate ordinary rubber protective clothing
- Materials which, under normal conditions, give off gases which are extremely toxic or corrosive through inhalation or through contact with or absorption through the skin

**5.2.2** Materials which, on short exposure, could cause serious temporary or residual injury even though prompt medical treatment was given. Types of these materials are:

- Materials giving off highly toxic combustion products
- Materials corrosive to living tissue or toxic by skin absorption

Provided by : www.spic.ir Licensee: NISOC Library

**5.2.3** Materials which, on intense or continued exposure, could cause temporary incapacitation or possible residual injury unless prompt medical attention is given. Types of these materials are:

- Materials giving off toxic combustion products
- Materials giving off highly irritating combustion products
- Materials which, under either normal conditions or fire conditions, give off toxic vapors lacking warning properties

**5.2.4** Materials which, on exposure, can cause irritation but only minor residual injury even if no treatment is given. Types of these materials are:

- Materials which, under fire conditions, give off irritating combustion products
- Materials which cause irritation to the skin without destruction of tissue

**5.2.5** Materials which, on exposure to fire conditions, offer no hazard beyond that of ordinary combustible material.

**5.3 FLAMMABILITY HAZARDS OF COATINGS MATERIALS:** A coating material may be considered a flammability hazard when it will burn under normal conditions.

Virtually all solvent solution coatings are highly flammable in liquid form, and vapors released in the process of application are explosive in nature if concentrated in sufficient volume in closed or restricted areas. Even vapors from ordinary enamels and oil paints may be accumulated in such density as to result in explosive reaction if a source of ignition is present. Generally speaking, however, solvents used in solvent solution coatings are more volatile and dangerous than those used in conventional paints or coatings.

Degrees of hazard are ranked according to the susceptibility of materials to burning, as follows:

**5.3.1** Materials which will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature, which are readily dispersed in air, and which will burn. Types of these materials are:

- Any liquid which is liquid under pressure and having a vapor pressure greater than 14.7 psig (101 kPa) at 38 °C (100 °F)
- Materials which may form explosive mixtures in air, such as mists of flammable or combustible liquid droplets

**5.3.2** Materials that can be ignited under almost all ambient temperature conditions. These materials produce hazardous atmospheres with air under all ambient temperatures and are readily ignited. Types of these materials are:

- Materials having a flash point of 38 °C (100 °F) or below and having a vapor pressure not greater than 14.7 psig (101 kPa) at 38 °C (100 °F)
- Materials which ignite spontaneously when exposed to air

**5.3.3** Materials that should be moderately heated or exposed to relatively high ambient temperature before ignition can occur. Materials of this type are those having a flash point above 38 °C (100 °F) but not greater than 93 °C (200 °F).

**5.3.4** Materials that should be preheated before ignition can occur. These materials are those that will support combustion for five minutes or less at 815 °C (1,500 °F).

**5.3.5** Non-combustible materials.

**5.4 TOXICITY OF COATING MATERIALS:** Some of the pigments used in organic coating materials are toxic. Lead compounds and chromates are particularly dangerous, whether ingested or inhaled. Some paint additives, such as the mercurial compounds used to impart fungicidal properties, may be toxic if ingested.

The epoxies used in epoxy coatings and compounds are particularly irritating to the skin, and some persons are seriously affected by allergic reactions if proper hygiene is not practiced. Common reactions include swelling around the eyes or lips, rashes of the skin, etc. Some epoxy coatings have polyamides as curing agents that react much like a mild acid on tender mucous membranes.

The following basic safety precautions should govern the use of ALL coatings:

- Know the material with which you are working.
- Read and follow the precautions on the label.
- Always provide adequate ventilation (OSHA Standard 29 CFP 1910.94).
- Guard against fire, flames, and sparks, and do not smoke while working.
- Avoid breathing of vapors or spray mist.
- Use protective skin cream and other protective equipment.
- Avoid ingestion of toxic materials.
- Wash hands carefully before eating or smoking.
- Change clothing that has soaked up toxic materials. Practice good personal hygiene.

## 6. Solvents

**6.1** A wide variety of solvents are used in the formulation of modern coatings. Many of these solvents are highly flammable and must be handled with extreme care. In addition, these solvents are toxic to varying degrees and may cause serious effects to those working with them. Excessive breathing of concentrated solvent vapors may

Provided by : www.spic.ir Licensee: NISOC Library

cause dizziness or nausea, excessive drying or irritation of the mucous membranes, and in rare cases, allergic reactions to the skin.

**6.2** Even common solvents that are ordinarily considered innocuous may be harmful if inhaled in high concentrations or for prolonged periods. For example, turpentine can cause narcotic poisoning and kidney damage when excessive amounts are inhaled. Systemic damage may also result from an acute dose (sufficient to produce unconsciousness), or from repeated excessive inhalation of such common solvents as acetate esters, alcohols, or ketones. Solvents such as toluene, xylene, ethyl ether, cyclohexanone, butyl alcohol, and the nitroparaffins have a relatively low chronic toxicity, but their narcotic effect in high concentrations can lead to unconsciousness followed by respiratory failure and death unless the victim is promptly restored to fresh air. Even the least toxic of the common paint and lacquer solvents can be dangerous in very high concentrations because of their narcotic effect, excepting the alcohols which are irritants (to the eyes and upper respiratory tract) rather than toxicants.

**6.3** Some common solvents usually not used directly in paints but often encountered in paint removers and cleaning liquids are dangerously toxic even at relatively low concentration; for example, methyl alcohol when inhaled or ingested repeatedly or to the point of unconsciousness may cause death or permanent blindness. Benzene is a dangerous, cumulative poison that causes severe damage to the liver and blood-forming tissues of the body. Many chlorinated solvents, particularly chlorinated aliphatic hydrocarbons, are toxic; chloroform, for example, has poisonous after-effects, while carbon tetrachloride and seldom used tetrachloroethane are dangerously toxic with severe chronic, cumulative effects on the kidneys, liver, and lungs. Since solvent-type paint removers frequently contain highly toxic solvents, they should be used only with adequate ventilation controls and/or respiratory protection.

**6.4** The toxic systemic effects of organic solvents can be produced by absorption through the skin as well as by inhalation. Acute or chronic dermatitis or systemic poisoning may result from repeated or prolonged contact of toxic solvents with the skin. Sometimes, the vehicle resin itself may be irritating or toxic to the skin while the resin is in the uncured state. The catalysts or hardening agents (e.g., organic amines) used in two-component coating systems are frequently volatile and toxic materials until they have been incorporated into the resin.

**6.5** Avoid unnecessary or prolonged contact with the skin; the use of protective clothing and skin creams can eliminate the need for scrubbing the skin with toxic solvents. If the maximum allowable concentration of solvent in the air is exceeded, then fresh air masks should be supplied for the workmen.

## 7. Airless Sprayers

**7.1** As far as practicable, the recommended safety precautions of the National Safety Council as published in their Industrial Data Sheet No. D-296, "Bridge Painting" should be followed, particularly when working outdoors or on elevated structures.

**7.2** Particular care should be exercised when working in closed spaces, especially when spraying.

- Equipment and work should be grounded.
- Use only nonsparking tools.
- Keep matches, smokes, and open flame away from the area.

**7.3** Airless guns of the type which atomize paints and fluids at high pressure—1,000 pounds or more to the square inch (6900 kPa)—should be equipped with automatic or visible manual safety devices which cannot permit the operator to pull the trigger and release the fluid until the safety is manually released.

If the gun has no safety control, it should have a diffuser nut which will prevent high velocity release while the nozzle tip is removed, plus a nozzle tip guard which will prevent the tip from coming into contact with the operator.

**7.4** In airless spraying, an unpressurized reservoir is used, as pressure is applied only to the paint in the pump, line, and spray gun. This type of spray represents a hazard of hypodermic injection of paint into persons who accidentally contact the stream.

The extremely high fluid pressure developed in airless spray painting equipment causes a powerful stream of paint to be discharged for some distance. THIS PRESSURE REMAINS IN THE SYSTEM EVEN THOUGH THE PUMP HAS BEEN SHUT OFF AND CAN BE RELIEVED ONLY BY BEING DISCHARGED THROUGH THE GUN.

The pressure is also dangerous when the nozzle has been removed. Some equipment is provided with a device that will prevent a hypodermic stream whenever the tip has been removed and the trigger squeezed.

Extreme care should be taken when pressure is being relieved from the system, and manufacturer's recommendations should be followed.

**7.5 SAFE OPERATING PRACTICES:** If safe operating practices are followed, reasonable care exercised by the operator, and equipment maintained in good order, the airless spray painting method is as safe as conventional methods. The following precautions should be part of every operator's training and should be strictly observed and rigidly enforced:

Provided by : www.spic.ir Licensee: NISOC Library

**7.5.1** Check all hose connections and fittings to ensure that they are tight and not leaking. The fluid hose should be designed to withstand the high pressure to which it is subjected. The hose, gun, and pressure vessel should be equipped with special fittings not interchangeable with low pressure fittings.

**7.5.2** Check the fluid hose to be sure that there are no weak or worn spots. Make certain the hose does not contact moving parts of machinery, or lie over and around sharp edges and corners, or come near objects that would damage it. Check for deterioration due to the exposure to chemicals or ordinary wear and tear. High pressure leaks from the hose or from the connections can cause hypodermic injections just as the gun tip can.

**7.5.3** Do not disconnect the gun from the fluid hose or the hose from the pump until the pressure has been released from the hose. This is accomplished by first closing off the main line air pressure to the pump and then bleeding off the pressure in the fluid hose by triggering the gun.

**7.5.4** When handling the gun but not actually spraying—for example, while changing piece parts or work position—hold the gun by the grip and remove the fingers from the trigger.

**7.5.5** NEVER POINT AN AIRLESS GUN AT ANY PART OF THE HUMAN BODY—YOUR OWN OR ANYONE ELSE'S!

**7.5.6** Airless spray guns cannot be cleaned with the same methods used for conventional air-operated guns. It is hard to force waste material out of the gun except through its head, and material released at such high pressures can be driven into the fingers or hand if they are held over the spray cap or head of the gun.

**7.5.7** The gun should have a guard which completely protects the trigger. When the gun is under pressure but not being used, the safety latch should be kept in the non-operating position.

**7.5.8** If production rates or paint usage rates are to be increased, or solvent changes made, existing controls should be reviewed to maintain safe conditions.

**7.6 RULES FOR SAFETY WITH PRESSURIZED EQUIPMENT:** The following safety rules apply to conventional and airless spray equipment, sandblasting equipment, and water blasting equipment that operate under pressure.

**7.6.1** Use only pressure equipment that has been constructed as specified by the National Board Code and the ASME Code for Unfired Pressure Vessels.

**7.6.2** Test safety relief valves used on pressure equipment daily.

**7.6.3** Use remote control deadman valves with pressure equipment. Be sure that the deadman valves are a pneumatic type that use the same air for activation that is used for blasting or spraying.

## 8. Ladders

**8.1 GENERAL SAFETY RULES:**

**8.1.1** See that all ladders conform to ANSI A14.1, "Ladders - Portable Wood - Safety Requirements" and ANSI A14.2, "Portable Metal Ladders."

**8.1.2** Inspect ladders frequently. Look for loose steps or rungs; loose screws, bolts, metal braces, and rods; split or broken side rails or rungs; and loose or bent hinge spreaders.

**8.1.3** When ladders are found to be lacking in any safety device or to be defective in any manner, they should not be used. Ladders found to be too defective for repairs should be destroyed.

**8.1.4** Protect ladders with clear protective coatings so that cracks, splinters, or breaks will be readily visible.

**8.1.5** Store ladders in a warm, dry place protected from contact with the ground.

**8.1.6** Equip all straight and extension ladders with safety shoes, unless special conditions prohibit their use.

**8.1.7** Do not use portable ladders greater than 60 feet in height. If greater heights are to be reached, provide intermediate landing platforms and use separate ladders.

**8.1.8** Single ladders not constructed for use as sectional ladders should not be spliced together to form a longer ladder.

**8.1.9** Extension ladders should not be taken apart in order to use either section separately.

**8.1.10** Extension ladders should have a minimum of 15% overlapping of each section.

**8.1.11** Ladders made by fastening cleats across a single rail should not be used.

**8.1.12** Do not use stepladders over 20 feet in height.

**8.1.13** Never use a stepladder as a straight ladder.

Provided by : www.spic.ir Licensee: NISOC Library

**8.1.14** Never use the platform of a stepladder as a top step on which to stand.

**8.1.15** In placing portable ladders, be sure that the horizontal distance from the top support to the foot of the ladder is one quarter of the working length of the ladder.

**8.1.16** Straight and extension ladders should be "tied-off" when in use. A helper should hold the ladder while it is being tied or untied at the top.

**8.1.17** When it is necessary to place a ladder over a doorway, the doorway should be roped off and signs should be erected to warn users of the door of the ladder's presence.

**8.1.18** Ladders should never be used as skids, braces, scaffold members, or for any other purpose than that for which they are intended.

**8.1.19** DO NOT USE METAL LADDERS OR STAGES IN AREAS WHERE CONTACT WITH ELECTRIC POWER LINES IS POSSIBLE.

**8.1.20** Use hand lines, not ladders, to raise or lower materials and tools.

**8.1.21** Do not reach too far in any direction while working from a ladder. Frequent changes in a ladder's position can forestall accidents from this source.

**8.1.22** Always face the ladder when ascending or descending.

**8.2** All ladders should be supported so that they are level at the base and given sufficient bearing so that they cannot sink into the supporting surface. Both hands should be free when climbing ladders. It is preferable that the hands hold the sides of the ladder, rather than the rungs, when going up or down.

**8.3** The following table is the minimum for the construction of wood ladders.

**8.4** The following table is the minimum for the construction of a double wood ladder. Double ladders over 24 feet in length should not be used.

**TABLE 1**
**DIMENSIONS FOR WOOD LADDERS**

| Cross-section Length in feet | Inside Width in Inches | | | |
|---|---|---|---|---|
| | Bottom | Top | Uprights | Cleats |
| 10 to 12 | 20 | 17 | 2" x 4" | 7/8" x 3" |
| 12 to 16 | 21 | 18 | 2" x 4" | 7/8" x 3" |
| 16 to 20 | 23 | 20 | 2" x 6" | 7/8" x 3" |

**TABLE 2**
**DIMENSIONS FOR DOUBLE WOOD LADDERS**

| Inside Wide Left Side | Right Side | Cross-Section Uprights | Cleats |
|---|---|---|---|
| 18" | 18" | 2" x 4" (to 12 ft)<br>2" x 6" (12-24 ft) | 1" x 3" |

## 9. Scaffolding

**9.1** Scaffolds should be provided for all work that cannot be done from the ground or from solid construction, except such work as can be done safely from ladders.

**9.1.1** Scaffolds, platforms, runways, etc., should be kept free from loose sand, mud, grease, or other materials, any one of which could cause slipping, tripping, or overloading.

**9.1.2** Stairs, ladders, or other safe means of access should be provided to all work areas. The use of cross members or framework as a means of access to working areas should not be permitted.

**9.1.3** All rolling scaffolds should be equipped with a positive locking device to prevent accidental movement of the scaffold.

**9.1.4** The sections of metal scaffolds should be securely connected together using the regular patented and manufactured connections. Improvised connections, such as a turn or two of rope, should not be permitted.

**9.1.5** Runways, ramps, platforms,, and scaffolds over six feet in height should be effectively guarded by the careful and workmanlike installation of guard or hand rails of 36 inches to 42 inches from the deck, with an intermediate rail and toe boards, not less than six inches in height, or side screens, as necessary, to protect workmen or property below from falling objects.

**9.1.6** All metal ladders, scaffolds, towers, and similar equipment should be erected in accordance with manufacturer's specifications and load limits should not be exceeded.

**9.1.7** Discarded packing boxes, barrels, piles of loose lumber, or other makeshift or "jury" rigging, should not be used for scaffolds or as supports.

**9.2 GENERAL SAFETY RULES FOR SCAFFOLDING:**

**9.2.1** Inspect all equipment before using. Never use equipment that is damaged or deteriorated in any way, especially rusted.



Provided by : www.spic.ir Licensee: NISOC Library

**9.2.2** Inspect erected scaffolding regularly to make sure it is maintained in safe conditions. Consult the scaffolding supplier when in doubt.

**9.2.3** Provide adequate sills for scaffold posts and use baseplates.

**9.2.4** Plumb and level all scaffolds as the erection proceeds. Use adjusting screws instead of wood blocks to adjust for uneven grade conditions. Do not force braces to fit—level the scaffold until proper fit can be made easily.

**9.2.5** Fasten all braces securely. Do not climb across braces.

**9.2.6** On wall scaffolds, place and maintain anchors securely between structure and scaffold at least every 30 feet of length and 25 feet of height.

**9.2.7** When scaffolds are to be partially or fully enclosed, specific precautions should be taken to assure the frequency and adequacy of ties attaching the scaffolding to the building. This is because of increased load conditions resulting from wind and weather. The scaffolding components to which the ties are attached also should be checked for additional loads.

**9.2.8** Freestanding scaffold towers should be protected against tipping by guying or other means.

**9.2.9** Equip all planked or staged areas with proper guard rails and add toeboards as required.

**9.2.10** Use of metal scaffolds near electric power lines is dangerous.

**9.2.11** Never use ladders or other makeshift rigs on top of scaffolds to increase the height.

**9.2.12** Do not overload scaffolds.

**9.2.13** All brackets should be seated correctly with side brackets parallel to the frames and end brackets at 90 degrees to the frames. Brackets should not be bent or twisted from normal position.

**9.3 FOR ROLLING SCAFFOLDS, THE FOLLOWING ADDITIONAL RULES APPLY:**

**9.3.1** Do not ride on rolling scaffolds.

**9.3.2** Remove all material and equipment from the platform before moving the scaffold.

**9.3.3** Caster brakes should be set at all times when scaffolds are in a fixed position. Casters with plain stems should be attached to the panel or adjustment screw by pins or other suitable means.

**9.3.4** Do not attempt to move a rolling scaffold without sufficient help. Watch out for holes in the floor or overhead obstructions.

**9.3.5** Do not extend adjusting screws on rolling scaffolds more than 12 inches.

**9.3.6** Use horizontal diagonal bracing near the bottom and at 20-foot intervals upward from the rolling surface.

**9.4 WHEN PUTLOGS AND TRUSSES ARE USED, THE FOLLOWING ADDITIONAL RULES APPLY:**

**9.4.1** Do not cantilever or extend putlog-trusses as side brackets without thorough consideration for the load to be supplied.

**9.4.2** Putlog-trusses should extend at least six inches beyond the point of support.

**9.4.3** Place proper bracing between putlog-trusses when the span of the truss is more than 12 inches.

**9.5 FOR METAL SCAFFOLDING, THE FOLLOWING RULES APPLY:**

**9.5.1** Provide adequate sills or underpinnings on all scaffolds to be erected on filled or otherwise soft ground.

**9.5.2** Compensate for unevenness of ground by using adjusting screws where blocking is not practical.

**9.5.3** Be sure that scaffolds are plumb and level at all times.

**9.5.4** Anchor running scaffolds to wall approximately every 28 feet of length and 18 feet of height. Use additional care when using pulley arms.

**9.5.5** Do not force braces to fit. Adjust levels of scaffolding until the proper fit can be made with ease.

**9.5.6** Horizontal diagonal bracing should be used to prevent racking of all scaffolds at bottom and intermediate levels of 30 feet.

**9.5.7** Handrailing should be provided on all scaffolds regardless of height.

**9.5.8** Erect the scaffold in such a manner that a ladder is accessible and is lined up from top to bottom.

Provided by : www.spic.ir Licensee: NISOC Library

**9.6 FOR WOOD SCAFFOLDING, THE FOLLOWING ADDITIONAL RULES APPLY:**

**9.6.1** A good rule of thumb for the use of wood scaffolding is that first of all it should be erected by professionals qualified to do so and who know the safety factors involved.

**9.6.2** All scaffolding lumber and planks should be thoroughly inspected before using. The pieces should be sound, straight, and free of large knots. Never use even slightly damaged materials.

**9.6.3** Decking should be at least two planks wide. A back rail, intermediate rail and toeboard should be provided.

**9.6.4** Never overload a scaffold and be sure that all planking meets load demands.

**9.6.5** Use a ladder to gain access to scaffolds. Never climb up and down on the horizontal pieces and be sure the scaffold is anchored or tied securely at the top.

**9.6.6** On any kind of a scaffold, be sure overhead protection is provided when there are others working directly above you.

**9.6.7** Keep scaffolds free of rubbish, waste, snow, ice, and ail other potential tripping and slipping hazards.

**9.6.8** A good way to be safe in determining the minimum size of planks and their maximum distance between supports is to use the following table:

**9.6.9** Scaffold planks should extend over their end supports not less than six inches nor more than 12 inches.

**9.6.10** All nails used in scaffold construction should be driven full length. No nail smaller than 8d should be used in scaffold construction, and a sufficient number of nails should be driven to support the design loading. Design of the scaffold should be such that no nail is subject to a direct pull

**9.7 RULES FOR SAFETY WITH PLANKING:**

**9.7.1** All planking used on a scaffold should be of sound quality lumber that is straight grained and free of knots. All planking should have at least 24 inches overlap. Secure all planks to wood scaffolding.

**9.7.2** Planking overhang should be 3 5/8 inches on stackup scaffolds. Wood cleats (1 inch x 4 inches) should be nailed across the top of planking at each frame and outside end frames.

**9.7.3** Planks used for platforms should be of uniform thickness. These planks should be laid close together and overlapped at the bearers. An overlap of at least two feet should be allowed with the bearer in the center of the overlap. Planks should be fastened securely to the bearer at the opposite end to prevent tipping.

**TABLE 3**
**SIZE AND SPAN OF PLANKS**

| Size of Plank, Inches | Span Allowed, Feet |
|---|---|
| 2 x 10 | 10 |
| 2 x 12 | 12 |
| 2 x 14 | 14 |
| 2 x 16 | 16 |
| 2 x 20 | 20 |
| 2 x 30 | 20 |

**9.7.4** Platforms should be kept clear of slippery substances. They should be equipped also with handrails and ladders.

**9.7.5** Planking should never be painted over; paint can conceal defects. Scaffold boards should be identified by painting at each end. All scaffold board should be used exclusively for that purpose.

**9.7.6** The nominal size of planking should be determined from Table 4. Values given are for planks with the wide face up, with loads concentrated in the center. Loads given in the table are net. Allowance was made for the weight of the planking. Loads in the table may be increased 45% if select structural coast region Douglas Fir or merchantable structural square and solid Southern Pine planks are used.

**9.8** Some additional precautions are necessary, in addition to the above where applicable, in the erection of rolling towers:

**9.8.1** Casters should be of adequate size in relation to the height of the tower, the surface over which the tower is to be used, and in accordance with all federal, state, and local codes, ordinances, and regulations. Casters with plain stems should be attached to the panel or adjustment screw by pins or other suitable means required to prevent sliding off the support. In no case should casters smaller than six inches in diameter be used.

**9.8.2** Do not extend adjusting screws on rolling towers more than 12 inches.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 4**
**SAFE CENTRAL LOADS FOR SCAFFOLD PLANK IN POUNDS**

| | Size of Plank | | | |
|---|---|---|---|---|
| Span in Feet | 2 x 10 Dressed to 1-5/8 x 9-1/2 | 2 x 12 Dressed to 1-5/8 x 11-1/2 | 3 x 10 Dressed to 2-5/8 x 9-1/2 | 3 x 12 Dressed to 2-5/8 x 11-1/2 |
| 6 | 256 | 309 | 667 | 807 |
| 8 | 192 | 232 | 500 | 605 |
| 10 | 153 | 186 | 400 | 484 |
| 12 | 128 | 155 | 333 | 404 |
| 14 | 110 | 133 | 286 | 346 |
| 16 | | 116 | 250 | 303 |

**9.8.3** The platform height should not exceed four times the smallest base dimension unless guyed or otherwise stabilized.

**9.8.4** Horizontal diagonal braces should be used near the bottom and at 20-foot intervals measured from the rolling surface.

**9.8.5** Cross brace both sides of every tower.

**9.8.6** The addition of ladders to the tower can provide a convenient means of ascending and descending.

**9.8.7** Install guardrails and toeboards.

**9.8.8** Towers of a height greater than three times the minimum base dimensions should be guyed or tied-off when in use.

**9.8.9** Apply all caster brakes when the tower is not in motion.

**9.8.10** DO NOT RIDE TOWERS!

**9.8.11** Do not attempt to move a rolling tower without sufficient help.

**9.8.12** Provide unit lock arms on all towers.

**9.8.13** The 5' x 7' rolling tower now in general use is un-stable at heights over 25 feet while in motion; stability should be maintained either with outriggers or with handling lines.

**9.8.14** Guy or tie-off all fixed towers every 18 feet of elevation.

**9.8.15** Do not use brackets on rolling towers.

**9.8.16** Do not attempt to use scaffold as material hoist towers or for mounting derricks without first determining the loads and stresses involved.

**9.8.17** Inspect all tower parts before using. Do not use parts that are damaged or deteriorated. Remember that the strength of rusted materials is not known.

## 1O. Rigging

**10.1 GENERAL SAFETY RULES FOR SWING STAGES:**

**10.1.1** Every swing stage or scaffold should be rigged and operated under the direct supervision of an experienced rigger.

**10.1.2** Swing scaffolds and all supports should be so designed and constructed that they can sustain at least six times the maximum load for which they are intended.

**10.1.3** Swing scaffold platforms should not be less than 20 inches wide or more than 36 inches in overall width. The platform should be so shaped that it rests evenly on steel hangers or stirrups placed within eight to 18 inches from the ends of the platform planks. If wire rope slings are used, they should be of wire rope of at least 9,000 pounds breaking strength.

**10.1.4** If wood putlogs are used in place of steel hangers, the platform planks should overlap by at least one foot on each side of the putlogs.

**10.1.5** A swing scaffold should be tied adequately or anchored to the building to prevent swaying or tipping forward from the inside. No more than two men should use a swing stage at any one time (except on staging designed to carry the extra load factor to meet requirements of OSHA), and each should be equipped with a safety belt to which a safety lifeline has been attached to a substantial member of the structure and running to the ground. Safety lifelines should never be attached to the scaffold.

**10.1.6** Proper rope size for stages is not less than 3/4 inch Manila—1/2 inch nylon—and 3/4 inch Manila for safety lines.

**10.1.7** Scaffold platforms should be constructed of wood members graded as "structural" plank free from damage affecting its strength. Where platforms are constructed of two 2 x 10's or two 2 x 12's, side by side, they should be firmly cleated together to act as a unit. If 2 x 10's are used, the span of the platform between hangers or falls should not be more than ten feet. If 2 x 12's are used, the span should not be more than 12 feet.

Provided by : www.spic.ir Licensee: NISOC Library

**10.1.8** All hooks used as part of the rigging for scaffold supports should be closed or "moused," except for those used on lower blocks which support painters' rope hitches and the large supporting hooks that are in contact with the roof or parapet.

1**0.1.9** Hooks supporting scaffolds or staging should be made of mild steel (reinforcing steel is forbidden) and they should be free from flaws or other imperfections. Each hook should be capable of supporting a load four times that to which it will be subjected in service.

**10.1.10** The expected load per hook in service should include its share (normally half) of the total scaffold and rigging weight, plus the total weight of men and movable equipment and tools which should never be considered less than 500 pounds.

**10.1.11** All hooks should be provided with rings for tieback service. The ring should be fitted through a hole in the hook not less than five inches from the hook point.

**10.1.12** Each hook should be tied back to a substantial member of the structure with at least a 3/4 inch diameter Manila rope or equivalent. Where the rope blocks supporting scaffolds or bosun's chairs are not attached directly to hooks, the extension from the top block to the support should be wire rope at least 1/2 inch in diameter or equivalent, and sufficient protection should be required to prevent the wire rope from chafing.

**10.1.13** Lubricate the bearing points of swing stages frequently. Inspect the ratchet and lock pawl spring before each use and keep pawls constantly engaged except when unreeling cable or lowering scaffold. Close inspection of masonry for possible deterioration is essential.

**10.1.14** Guard rails should be 2 x 4 inches or the equivalent, approximately 42 inches high, with a mid-rail not to exceed eight feet. Toeboards should be a minimum of four inches in height. Guard posts, if constructed of pipe, should not be less than 1-1/4 inches in diameter, securely screwed into floor flanges which in turn are bolted to the outside board of the platform.

**10.2 ACID OR OTHER CORROSIVE SUBSTANCES USED FOR CLEANING MAY BE APPLIED FROM A SWING STAGE ONLY UNDER THE FOLLOWING CONDITIONS:**

**10.2.1** The stage should be suspended only by means of cable. Use of fiber rope of any kind is prohibited.

**10.2.2** A highly diluted solution of hydrochloric or muriatic acid, or other chemicals designed for cleaning work, should be used. Do not add water to acids. In diluting acids, the acid should be added to the water—slowly.

**10.2.3** The workmen should wear approved protective equipment. The solution should be applied with a brush.

**10.2.4** All parts of the scaffold or other equipment should be liberally washed with water, or detergent and water, after each use to prevent corrosive action.

**10.2.5** Be sure wire rope does not dangle below the platform and is well protected from acids or cleaning solutions. Manila rope which has been used for any purpose where it may have come into contact with acids, harmful detergents, etc., should be discarded.

**10.3 ADDITIONAL SAFETY RULES FOR SWING STAGES:**

**10.3.1** Be sure to read the manufacturers' instructions on the proper use and maintenance of the equipment.

**10.3.2** Never overload equipment.

**10.3.3** Always use a guard rail of sound lumber. Never substitute with rope.

**10.3.4** Replace cables immediately that show five percent of the wires per layer broken or that show evidence of excessive wear or corrosion.

**10.3.5** Cables should be replaced only by experienced personnel, and then with the utmost care.

**10.3.6** Allow none but careful, experienced workers to erect or operate the suspended stage.

**10.3.7** When locating cables on the jobsite, CHECK NEARBY POWER LINES OR ELECTRIC SERVICE WIRING TO PREVENT ELECTROCUTION. When in doubt, consult the power service company for advice.

**10.3.8** Wood stages should be 20 inches minimum width, rated by Underwriters' Laboratories for center load of 500 pounds with safety factor of 4. Wood stages over 24 feet in length should be cabled.

**10.3.9** Metal stages should be not less than 20 inches wide, rated by Underwriters' Laboratories for center loads of 500 pounds with safety factor of 4. Stages over 24 feet in length should be cabled, with no cracks in sidewalls.

**10.3.10** Ropes and blocks of the stage should be tested by suspending one foot off the ground and loading at least four times the estimated work load.

**10.3.11** Power devices should have free fall safety devices with hand controls in case of power failure. Cables

Provided by : www.spic.ir Licensee: NISOC Library

should be inspected regularly. Safety factor of cables should be four to one.

**10.4 SAFETY RULES FOR "BOSUN'S CHAIR":**

**10.4.1** No workman should be allowed to use a bosun's chair who is not competent to operate it or who is unsuited to the conditions imposed.

**10.4.2** A worker in a bosun's chair should be attended by another worker at all times.

**10.4.3** The seat of the chair should be constructed of a minimum of one-inch hardwood, 24 inches in length by 12 inches in width. Tie-ins should always be provided to prevent the chair and its occupant from swaying during working operations.

**10.4.4** The lifeline should be equipped with an approved automatic locking device or "grab." The line should be extended from a separate anchorage on the roof to the ground and should be separate from the rest of the rigging.

**10.4.5** The two fiber rope seat slings should be of 5/8 inch diameter, threaded through the four seat holes so as to cross each other on the underside of the seat. A safety belt attached to the lower tackle hook or other fixed supports should be used by the occupant.

**10.4.6** A rope or strap guard should be installed to the front and rear of the chair 18 inches above the seat.

**10.4.7** To raise and lower the chair, use a rope tackle with not less than one single and one double block equipped with an approved safety hook with mounting device, using not less than a 5/8 inch rope or cable of equivalent strength.

**10.4.8** When the rope passes over sharp edges, necessary precautions should be taken to protect the rope.

**10.5 GENERAL SAFETY RULES FOR RIGGING:**

**10.5.1** Superintendents and foremen should supervise all rigging and make sure it is safe. When left overnight or over a weekend, rigging should be checked before being used. At no time should rigging be tied to handrails, etc.

**10.5.2** Block hooks should be moused off with wire to make sure they cannot jump out. The main spider cable should not be used to tie off.

**10.5.3** Make sure all scaffold boards have from 12 to 18 inches overhang; if not, make sure they are tied on both ends in order not to slip.

**10.5.4** Approved safety belts and lifelines should be worn by employees whose work exposes them to falling in excess of 15 feet. Lifelines should be secured to a substantial member of the structure or to securely rigged lines, using a positive-descent control device.

**10.5.5** If a worker's duties require horizontal movement, the rigging should be so constructed that the attached lifeline can slide along with him. Such rigging should be provided for all suspended staging, outdoor advertising sign platforms, floats, and all other catwalks or walkways 15 feet or more above ground level.

**10.5.6** When working on steeply pitched roofs, workmen should wear safety belts with lifelines securely fastened to substantial anchorages. Electrical or air supply lines should be secured at roof level so as to provide ample, but not excessive, amounts of line.

**10.6 GENERAL SAFETY RULES FOR ROPES:**

**10.6.1** When it is properly taken care of, old-fashioned Manila hemp is still a mainstay, although many of the newer plastic fiber synthetics have gained many converts because of their rotproof, long life, and lighter weight characteristics.

**10.6.2** Ropes made of such synthetics as nylon and dacron have several times the minimum breaking strength of Manila hemp and can last several times longer because of low moisture absorption, rot and mildew resistance, and abrasion resistance, according to some manufacturers. In hot areas, these synthetics are subject to failure by melting.

**10.6.3** A safe working load for Manila should be not more than one-quarter of the breaking strength. In the larger sizes, inside yarns are treated to withstand more rugged service and are reverse twisted to prevent kinking of the rope.

**10.6.4** When not in use, rope should be stored in dry, unheated quarters—preferably coiled and hung on wood planks or platforms slotted to allow for air circulation. It is important to store rope away from concrete floors and protect it from freezing, hot sunshine, heater pipes, stoves, radiators, or other heat sources. When rope fibers dry out and become brittle, much of the strength and durability is lost.

**10.6.5** Keep rope clean. If it gets dirty, wash it with clean water. A wet rope should be dried thoroughly before storing. Ropes seldom need lubrication. A well-made rope is sufficiently lubricated by the manufacturer to last for its entire service life.

**10.6.6** Overloading rope is costly and dangerous. The safety factor of a rope is the ratio between the minimum

Provided by : www.spic.ir Licensee: NISOC Library

breaking strength and the load applied. A safety factor of five is recommended under ordinary circumstances, with due allowance for the condition of the rope.

**10.6.7** When ropes used as guy lines and other supports are exposed to weather, they should be slacked off to prevent overstrain due to shortening from wetting.

**10.6.8** It is good practice to reverse a rope periodically, end for end, as in tackle use, so that all sections of the rope receive equal wear. When rope wear is localized in a short section, periodic shortenings prevent the creation of a new wearing surface.

**10.6.9** Should a rope become damaged, cut and splice it. A good splice restores about 90% of the strength of the rope and is safer than a damaged section. Surface wear may come from allowing one rope to chafe another, or by dragging it over sharp or rough objects which cut or break the outer fibers.

**10.6.10** Under conditions where rope should necessarily run over blocks, winches, or cleats, be sure the surface is smooth and free from worn grooves, sharp corners, and the like.

**10.6.11** Pull the strands of rope apart and check the inside strands. If you can break one by pulling it, chances are that the rope is rotted and unsafe. A worn rope usually can be detected by the black, powdery appearance that can be seen between the strands when they are untwisted.

**10.6.12** When wire rope is used, it should be maintained in strict accordance with the recommendation of the manufacturer for the appropriate safe working load. A safety factor of not less than five is recommended at all times.

**10.6.13** Kinking and twisting of the wire rope should be avoided and at no time should a load be applied to a kinked rope. The use of anti-twist rope is recommended. Wire rope should be lubricated according to the manufacturer's specifications.

**10.6.14** Sources of friction between wire rope and other objects should be avoided as it can cause chafing or breaking of the wire of the overlay cables.

**10.6.15** Wire rope should be protected from acids.

## 11. Personnel Protection

**11.1 GENERAL RULES FOR SAFE WORKING CONDITIONS:** The project superintendent and the painter foreman, with advice from the safety engineer or industrial hygienist, should be alerted to see that the following rules are obeyed.

**11.1.1** Check tank or other enclosed space interiors for explosion hazard, toxic materials, and adequate oxygen content for breathing. Before tank entry, provide life lines and harness with an extra man stationed outside the tank. Ascertain if the tank opening is large enough to remove an injured man. Before entering a tank, check with operating personnel to ensure that all process lines entering the tank are blanked off.

**11.1.2** Provide proper lighting in interior of tanks and other dark areas. Be sure that lighting does not create shadows or glare. All wiring should be so constructed that there is no danger of electric shock. In many instances, electric head lamps such as are used in mines may be used.

**11.1.3** When airline masks or hose masks are used, locate the intake air source or the blower in an area free from air contaminants. Check the output air for proper pressure and carbon monoxide content (cf. Federal Specification BB-A-1034). Protect hoses from damage and do not allow them to become tripping hazards.

**11.1.4** Rope off or barricade work areas as required to protect passersby.

**11.1.5** Provide an adequate number of portable fire extinguishers.

**11.1.6** Post warning signs which may include: "WET PAINT," "NO SMOKING," and "MEN WORKING ABOVE."

**11.2** The employer should provide the employee special protective clothing and equipment as safety conditions require and where the same is not similar to what is normally worn or provided as tools of the trade. Examples of safety equipment to be provided by the employer are goggles, hard hats, and rubber gloves.

**11.2.1 Eye Protection:** Goggles or other suitable eye protection equipment should always be worn whenever there is the danger of exposing the eyes to flying particles, acid, caustic substances, harmful rays, or any condition considered hazardous by the supervisor of the operation. Goggles used for protection from harmful rays should also meet requirements for protection against impact hazards.

**11.2.2 Head Protection:** Approved hard hats should be worn at all times and on all work and by everyone on the jobsite without exception.

**11.2.3 Foot Protection:** When it is deemed necessary that rubber boots should be worn, they should be worn with

Provided by : www.spic.ir Licensee: NISOC Library

steel innerliners to help prevent punctures and stone bruises. All employees should be encouraged to buy and wear approved "Safety Shoes."

**11.3 PROTECTIVE CLOTHING:**

**11.3.1 Ordinary work clothing:** Tears and rips in work clothing are potential causes of accidents. Torn clothing can get caught in moving machinery or on a ladder or scaffold, and may lead to a nasty fall. Mend tears and rips. Cuffs on trousers are dangerous, since they might also catch on projections and cause crippling falls. Floppy jackets, dangling ties, and other similar items of clothing can catch in moving machinery, or may catch on projections and cause a fall.

**11.3.2** Oil or chemical-saturated clothing (or clothing saturated with paint or other flammable material) easily can lead to dangerous and fatal burns. Clothing saturated with these materials can also cause painful skin irritations and burns. Oil-saturated clothing should be laundered or discarded.

**11.3.3** Defective, poorly designed, ill-fitting, or dirty clothing should not be worn to work. It is false economy to tolerate worn out or dirty clothing or to permit employees to wear to work old clothing not designed for safety under on-the-job conditions.

**11.3.4 Protective Clothing for High Temperature and Highly Toxic Atmospheres:** Protective clothing capable of withstanding long operating temperatures of 260˚C (500˚F), and capable of providing protection from many highly toxic atmospheres has been produced. This type of clothing is a complete suit constructed of woven Teflon laminated to a film of FEP fluorocarbon with a layer of reflective metal vacuum deposited onto the FEP. The suit is complete with gloves, steel-toed boots, and helmet-type headpiece, all locked to the suit by sealing ring arrangements. (Details of this suit construction and use can be obtained from the Snyder Manufacturing Company, New Philadelphia, OH, or the E.I. du Pont Chemical Company.)

**11.3.5 Hard Hats, Safety Shoes:** Most industrial plants require that workmen wear rigid safety helmets and steel-toed safety shoes as a matter of basic safety protection. The files of industrial safety engineers and insurance companies contain a sufficient number of case histories to prove that safety depends on these devices of protection. Project superintendents and painter foremen should not permit a man to begin work on a job until he agrees to wear these items. Steel toe safety shoes should have rubber soles with no nails or brads exposed when the painter is to work in enclosed spaces where flammable vapors may be present.

## 12. Respirators

**12.1** When industrial work methods or processes create hazards of exposure to harmful vapors, gases, dusts, mists, or fumes, the work areas should be isolated and ventilated to eliminate or minimize the hazards.

**12.1.1** The American Standard Safety Code for Respiratory Protection, ANSI Z88.2, suggests in broad terms where protection is needed. The code does not spell out in detail the specific hazardous conditions requiring respiratory protection; instead, it provides that respiratory protection "shall be provided where a process presents the hazard of exposure to harmful vapors, gases, dusts, mists, or fumes."

**12.1.2 Approved Devices:** At the present time, respiratory protective devices are approved by National institute for Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA) in the following categories:

- Self-Contained Breathing Apparatus. The apparatus includes the compressed oxygen cylinder and the compressed air cylinder, demand type.
- Supplied Air Respirators. The apparatus includes hose masks with blower, Type A; special hose mask without blower, Type B; air-line respirator, Type C; abrasive blasting helmet, Type CE; dispersoid (dust, fume and mist) respirators; and nonemergency gas respirators (chemical cartridge respirators).

Because the selection of respiratory protective devices is based on the type of hazards encountered, The American Standard Safety Code for Respiratory Protection, ANSI Z88.2, classifies hazards as follows:

- Oxygen deficiency.
- Gaseous contaminants: Immediately dangerous to life, and Not immediately dangerous to life. Particulate contaminants (dust, fumes, smoke, mists, fogs).
- Combination of gaseous and particulate contaminants: Immediately dangerous to life, and Not immediately dangerous to life.

**12.1.4** It is suggested that self-contained breathing apparatus be used where oxygen deficiency and certain types of gaseous contaminant hazards exist and that supplied air respirators be used for the remaining types. However, it is always important to consult the plant or area safety engineer as to which type of protective device is best for a given condition.

**12.2 AIR-LINE RESPIRATORS:**

**12.2.1** Make certain that the air supply is respirable. Pay close attention to the location of the intake to the air supply device to make certain that the entering air is not

Provided by : www.spic.ir Licensee: NISOC Library

contaminated from the exhaust of the compressor engine or from other sources. Provide a suitable filter to remove objectionable odors, oil, water mist, and rust particles from the air delivered to the air supply line.

**12.2.2** Make certain that the air-line respirator is in good operating condition. Attach the proper length of air supply hose to the source of compressed air and to the breathing tube. Adjust the pressure of the air at the inlet to the air supply hose so that it is within the proper pressure range. Adjust the facepiece, helmet, or hood to the wearer according to the manufacturer's instructions.

**12.2.3** When the rate of flow of air into the facepiece, helmet, or hood seems to be excessive, the wearer may decrease the flow of air by means of the air regulating valve with which most air-line respirators are equipped. However, to prevent the contaminant in the surrounding air from reaching the wearer's breathing zone, the flow of air should not be decreased below four cubic feet per minute for facepieces, or below six cubic feet per minute for helmets or hoods. Enter the contaminated area cautiously and leave by the same route.

**12.2.4** For the safe use of any device, it is essential that the user be properly instructed in its selection, use, and maintenance. This is particularly important with respect to respirators. Competent personnel should give such instructions to the supervisors of all groups who may be required to wear respirators at their work. The supervisors, in turn, should instruct their men. No person should be allowed to wear a respirator of any type until he has received such instruction.

**12.2.5** The life of the wearer may be dependent on the proper functioning and ready availability of respirators, so it is highly important that respirators be properly maintained and stored.

**12.2.6** All respirators should be inspected at regular intervals to make sure that they are ready for use.

**12.2.7** All rubber parts such as facepieces, mouthpieces, exhalation valves, breathing tubes, and headbands should be inspected carefully for signs of deterioration such as hardening, checking, or tackiness. A check should be made during this inspection to see that all gaskets are present and that they are held tightly in place. Metal parts should be checked for signs of corrosion, and plastic and glass parts should be checked for breakage.

**12.3 GENERAL SAFETY RULES FOR RESPIRATORS:**

**12.3.1** If the wearer is to enter a confined space containing a hazardous atmosphere, first connect a strong lifeline to his body. The lifeline serves as a means of guiding him to the exit, as a means of exchanging prearranged signals between him and the man at the fresh air base, and as a means of aiding in rescue operations in case of an emergency or accident. The lifeline should be held by two attendants, one of whom is wearing a similar apparatus.

**12.3.2** Where a lifeline is used, a signal code to enable the wearer to communicate with the lifeline tender, and vice versa, is necessary. The following code is suggested:

**Tender to Wearer**
1 pull —Are you okay?
2 pulls—Advance.
3 pulls—Back out.
4 pulls—Come out immediately.

**Wearer to Tender**
1 pull —I am okay.
2 pulls—I am going ahead.
3 pulls—Keep slack out of line
4 pulls—Send help.

**12.3.3** If upon entering a contaminated area, the wearer is able to detect the contaminant by odor or taste, or by eye, nose, or throat irritation, he should return to the fresh air immediately and ascertain what is wrong with the equipment or the manner in which it is being worn. Bear in mind the time limitations of the apparatus and allow an adequate margin of time for return to fresh air. The mouthpiece and nose clip or the facepiece should not be removed until the wearer is certain that he is in respirable air.

**12.4 SAFETY RULES FOR RESPIRATORS:**

**12.4.1** Make certain that the hose mask is in good operating condition. Set the blower in an assured source of respirable air.

**12.4.2** Connect the proper length of hose (not over 150 feet) to the blower and to the facepiece, making sure that all gaskets are in place and that the connections are tight. Where more than one hose line is to be used, each should originate at the blower. Operate the blower for a minute or two at a rapid rate to blow any dust out of the hose and to make sure that air is being delivered to the facepiece.

**12.4.3** Adjust the body harness securely to the wearer. Connect a strong lifeline to the D ring of the body harness. Adjust the facepiece to the wearer so that it makes a gaslight fit with his face. Operate the blower, and adjust the flow of air to the wearer's satisfaction. The blower should be operated continuously during the use of the mask.

**12.4.4** Check on the prearranged signals between the wearer and the blower operator. Enter the contaminated

Provided by : www.spic.ir Licensee: NISOC Library

area cautiously. Be careful that the hose and the lifeline are not endangered by sharp edges or falling objects and remember that the wearer should retrace his steps and leave by the same route by which he entered.

## 13. Ventilation

**13.1** A clean air supply is required for all operations involved during the application of the coating materials, and during the curing and drying of the coating after application. This clean air supply is also required to provide make-up to the working atmosphere during these operations. A high quality air source is required for life support purposes.

**13.2** Air used to fulfill the requirements of coating will require monitoring prior to, during, and following use to assure proper quality. Effluent treatment is required for the removal of fumes, vapors, and particulates where monitoring analyses indicate that levels exceed the acceptable discharge limits.

**13.3 LIFE SUPPORT REQUIREMENTS:** The preparation of air used for life support involves the following factors:

- Threshold Limit Value (TLV) of nuisance and toxic dusts
- Fume, gas, and vapor content
- Air temperature

**13.4** The TLV for "inert" or nuisance particulates present in atmospheric air is given as 10 mg/m$^3$ of total dust containing less than 1% silica.

**13.5** Particles having an aerodynamic diameter of ten micrometers are capable of passing into the smallest passageways of the human lung. To produce an air supply acceptable for life support purposes, all particles greater than 2.0 micrometers should be removed from air, or the particulate concentration should be maintained at less than 5 mg/m$^3$ (whichever is lower).

**13.6** The fume, gas, and vapor content of respirable air is taken as the minimum quality required for life support. "Respirable Air" is considered to be that suitable for use in self contained or air-supplied breathing (SCUBA) equipment used in underwater operations. The air quality recommended for life support is defined as Type 1, Grade D, having the maximum limiting characteristics given in Table 5 below, except where exceeded by federal, state, or local regulations. [See Amendment 1 (12-15-78) to Federal Specification BB-A- 1034 (6 21 -68)].

**13.7** Temperature of the air required for life support is related to the existing relative humidity (dew point temperature), the extent of physical activity, and the air velocity. Although partly concerned with maintaining a proper work atmosphere, the optimum temperature should range between 70°F (21°C) and 80°F (27°C).

**TABLE 5**
**RESPIRABLE AIR TYPE I, GRADE D**

| | |
|---|---|
| Oxygen (v/v)* | 19.5-23.5%** |
| Hydrocarbons (condensed) | 5 mg/m$^3$ |
| Carbon monoxide | 10 mg/m$^3$ |
| Carbon dioxide | 1,000 mg/m$^3$ |

*v/v—volume per unit volume or percent by volume
**Balance (76.5-80.5) predominantly nitrogen

**13.8** Equipment used to supply air for life support should be located so as to prevent entrainment of exhaust from any nearby internal combustion engines.

**13.9** Air required for general ventilation, where separate life support supplies are not provided, should meet the quality criteria outlined in Section 13.6. Air volumes should be adequate to maintain the quality stated under any and all operating conditions.

**13.10** The ventilation system should be designed to facilitate removal of particulates and solvent vapors from the most remote and lowest areas of the work area.

## 14. Barricades

**14.1** Floor openings should be planked over or barricaded with substantial railings as follows:

- Minimum 2 x 4 top rail, 3'6" above floor level.
- Minimum 2 x 4 intermediate rail, equidistant between top rail and floor.
- Minimum 1" x 4" toeboard.

**14.2** Doorways and passageways used by workers should be protected from overhead dangers by suitable coverings.

**14.3** Barricades are to be placed at drives, entrances and other openings to keep the public out of the jobsite.

**14.4** Openings to material hoists, elevator shafts, stairways, and walkways should be closed by gates or other moveable barricades with toe guards as described above.

**14.5** The unnecessary removal of any protective barricade is prohibited. Temporary removal requires other safety control, such as the posting of a guard to direct traffic. Whoever removes a barricade should be responsible for its replacement.

All barricades and gates should be adequately lighted at all times.

Provided by : www.spic.ir Licensee: NISOC Library

**14.6** In cases where the type of construction requires routing of passersby over sidewalks and streets, the temporary work should comply with all relevant local, state, and federal regulations.

**14.6.1** Passageways should have handrails and toeboards to the street side and a solid eight foot-high wall to the building side, with substantial overhead protection, solidly decked.

**14.6.2** Walkways should be smooth and even, with no projections or knot holes which might cause tripping. A ramp is advisable at each end, with cleats, or nonslip surface.

**14.6.3** Passageways should be well lighted, with lights at each end.

**14.6.4** If equipment crosses walkway, traffic should be directed and frequent inspection of walkways made by the job superintendent.

**14.7** Good housekeeping is the first law of accident prevention in construction and should be a primary concern to all employees. The following rules should be known and heeded by each individual on the jobsite.

**14.7.1** Housekeeping should be part of the daily routine, with cleanup being a continuous work procedure.

**14.7.2** The work areas should be kept free of loose materials no longer needed at the jobsite. This is especially true in the vicinity of ladders, ramps, stairs, and passageways.

**14.7.3** An effective means of preventing careless litter should be provided: material trash bins and garbage cans should be placed in convenient locations so that workers can find it easy to keep the individual locations free from trash and other debris.

**14.7.4** Clean up all spilled grease, oil, paint, or other materials at once and remove waste material as it accumulates.

**14.7.5** All scaffolds, stairways, passageways and catwalks should be kept free from debris, supplies, and obstructions. Keep materials and supplies away from the edges of shafts, stairways, and floor openings.

**14.7.6** Follow good storage practices for tools, material, and equipment. Don't stack or store things in such a way that they can fall over and cause tripping hazards.

**14.7.7** Store waste, oily rags, and other flammable materials in metal cans or receptacles provided for that purpose.

**14.7.8** Flammable materials should be stored in closed, ventilated metal cabinets. Storage cabinets should be away from exits, stairways or doors used for exits.

**14.7.9** Cabinets should be identified with the sign: "FLAMMABLE—KEEP FIRE AWAY" (painted in red).

1**4.7.10** Do not return tools or equipment to stock until all items have been properly cleaned.

## 15. Additional Recommendations

**15.1** The hazards in using chemical compounds such as acids and alkalies are generally known and precautions should be taken to protect personnel from all contact, including spray, mist, or spillage. The Chemical Manufacturers Association has published adequate methods for handling these safely.

**15.2** The protective clothing and equipment necessary for the various operations is listed in publications of the National Safety Council, the American Standards Association, the National Fire Protection Association, and others. Insurance companies should be contacted for technical advice on safety measures if there is any question.

**15.3** Spray booth operations should be carried out in detached buildings or cut off from other functions where possible. Where it is done in open areas, curtains of noncombustible material hung from ceiling to floor are recommended.

**15.3.1** Heating units or piping within such an area should be eliminated or protected against an accumulation of paint spray. Positive ventilation equipment should be used at all times.

**15.3.2** Accumulations of paint should be removed from the walls, floor, and ceiling of a spray booth at frequent intervals.

**15.3.3** Exhaust systems should be designed so that there is a minimum amount of spray deposit left in ducts, which can be easily removed.

**15.3.4** Only approved explosion-proof electrical equipment should be used in the spray area.

**15.3.5** No more than a day's supply of paint and solvents should be kept in the area.

Provided by : www.spic.ir Licensee: NISOC Library

**15.3.6** Finished materials should not be stocked in front of or close to the spray booth where evaporating thinners from the freshly finished materials can be inhaled.

**15.4 PERSONNEL ACTIONS:**

**15.4.1 Goggles:** Rubber, splash-proof goggles should be on the person at all times and should be worn while chipping, wire brushing, scraping, dusting, spraying, removing glass, or when working in any area where the use of goggles is designated, as in sandblasting areas or where there is danger from weld spatter. Goggles should be kept clean and a nonfogging compound should be applied as often as necessary.

**15.4.2 Safety Belt:** Safety belts with lines attached should be worn when working inside any tank or small enclosure or on top of high equipment, such as tanks, bridges, structural steel work and water towers. When working from a bosun's chair, a lineman's safety belt should be worn. Safety belts should be tested once a month. Safety lines should be attended by a second person at all times.

**15.4.3 Air-Line Mask:** An approved air-line mask should be worn where specified. The air source for the mask should be taken from either a suitable pump supplied for the purpose; or it may be taken from a suitable compressor, if a stoneware or other suitable filter is used. Do not use any source from which an oil or greasy odor is obtained.

**15.5 PAINT SPRAY BOOTHS:** Design construction and operation of paint spray booths should comply with the many requirements listed in federal, state, and local regulating controls, as suggested in Section 2.

**15.6** Application of hot-applied bituminous coatings involves special hazards. Heating kettles are designed to minimize possibilities of the contents catching fire, but carelessness cannot be permitted. Splashing or the upsetting of buckets of hot melts, with temperatures ranging up to 500˚F (260˚C) can result in serious burns. Smoke and fumes are irritating to the skin, as well as harmful to the respiratory tract.

**15.7 ELEVATED OPERATIONS:**

**15.7.1** Since a painter on a bridge job is working at a considerable distance from ground or water, one of the main considerations is that he not suffer from vertigo, or fear of height.

**15.7.2** For their own protection, it is wise for men working regularly on high work, such as structural steel and bridges, to take regular physical examinations, so that any tendency toward vertigo or dizzy spells can be detected, as well as heart ailments or the effects of previous cases of lead poisoning.

**15.7.3** Catwalks or platforms should be at least 20 inches in width with guardrails provided at all locations where men are regularly at work. The planks should be rough sawn and pressure treated.

**15.7.4** All scaffolds, fixtures, hangers, cables, and ropes should be inspected by the foreman each day, or before each use. All standing or hanging scaffolds should be inspected daily for strains or weaknesses caused by wind sway.

**15.7.5** Ladders used for access to scaffolds or parts of the bridge should be securely lashed in place or provided with hooks on the top end.

**15.7.6** Special care is necessary in extremely hot or cold weather to make certain that life belts are used and are in condition. In very cold weather, a man's hands become numb and he may lose his grip and fall, while in very hot weather he may become dizzy.

**15.7.7** Another effective form of protection is the life net. It may be erected under either individual scaffolds or complete bays of the bridge. When used, the net should be inspected and kept in good condition.

**15.7.8** When scaffolds are used above railroad tracks, the planks should be securely fastened so the blast from locomotives passing underneath cannot dislodge them. Scaffold hooks should also be securely fastened in place.

**15.8 ELECTRIC FACILITIES:**

**15.8.1** Utmost care should be practiced by all personnel in the application of paints in or near electric lines and equipment. Inquiry should be made of the jobsite manager or operators to learn specific functions of local equipment and dry hazards relevant to such.

**15.8.2** Action should be taken to break the connection of the line or equipment from the power source whenever possible. The break area should be plainly marked and locked, with release controlled by the painting supervisor.

**15.8.3** All painters should be briefed by experienced supervisors on safe practices and precautions necessary around electric units prior to their doing any paint applications.

**15.8.4** Warning signs should be posted at all times with ample safe distances between them and electric units.

Provided by : www.spic.ir Licensee: NISOC Library

## 16. Limitations

**16.1 FIRE HAZARD:**

**16.1.1** Flammable, volatile solvents in paints constitute a major hazard with regard to fire and explosions wherever flame or spark exposure is possible. No painting should be done within 50 yards of steel welding or torchcutting activity.

**16.1.2** When painting is required in a confined area, all flame sources (pilots, lights, etc.) should be extinguished and no smoking permitted. Painting should cease whenever this condition may be breached, or when solvent vapor concentration reaches hazard level.

**16.1.3** Vapor exhaust equipment should be used to maintain minimum level of solvent concentration.

**16.1.4** The superintendents should acquaint themselves and their foremen with the fire hazards inherent in the job and jobsite.

**16.1.5** The use and storage of flammable materials are to be kept to restricted areas, and these areas are to be well marked with appropriate signs.

**16.1.6** Fire extinguishers and fire hoses should be placed at locations which are agreed upon or designated by the safety manager.

**16.2 TEMPERATURE RANGE:**

**16.2.1** Most paints should be applied when both ambient and substrate temperatures range from 406°F (4°C) to 120°F (49°C) with strong influence from the relative humidity condition in that bracket. The safety factor involved is the fire hazard with the rapid flash-off of solvent at the higher temperatures, or the formation of combustible vapor mixtures in low areas at the bottom of the range.

**16.2.2** Moisture and frost on surfaces create a footing hazard at lower temperatures. Personnel working at high temperatures may suffer heat exhaustion and risk falls from the access means. Daily warnings should be made if these conditions exist.

**16.3 WIND VELOCITY:**

**16.3.1** Exterior application of paint should cease when wind velocity reaches 25 miles per hour either in gusts or at a steady rate. Where surfaces can be shielded from wind by artificial deflection means, work may continue.

**16.3.2** At velocities of 25 miles per hour, all elevated access means should be lowered to ground level, unless complete immobilization can be made.

## 17. Action on Accidents

**17.1** First aid kits of the required size should be provided at the various jobsite offices. These kits should contain the essential articles for the immediate treatment of superficial injuries.

**17.2** Supervisors and foremen should satisfactorily complete the first aid course given by the American Red Cross. It is urged that as many as possible of the employees participate in a regular first aid course as presented by the American Red Cross. Each crew should have at least one person trained in first aid.

**17.3 REPORTING OF ACCIDENTS:**

**17.3.1** Details of ail accidents should be reported to OSHA and other government offices as soon as possible.

**17.3.2** Field offices should serve as first aid headquarters. Regardless how minor the injury is, all injuries should be reported in order that proper treatment may be obtained. Arrangements for doctors and transportation should have been made, with the telephone numbers and addresses posted at the field offices.

**17.3.3** A list containing the date and time that the injured person was sent for treatment should be kept at the jobsite office.

**17.3.4** All subcontractors should be required to furnish the superintendent a copy for the accident report within two hours of the time that an injury is reported.

## 18. Notes

**18.1** While every precaution is taken to insure that all information furnished in SSPC guides is as accurate, complete, and useful as possible, SSPC cannot assume responsibility or incur any obligation resulting from the use of any materials, paints, or methods specified therein, or of the guide itself.

**18.2 OTHER GENERAL REFERENCES ARE:**

- British Standards Institution, BS - 5493: Code of Practice for Protective Coatings of Iron and Steel Structures Against Corrosion.
- OSHA Reference Manual, Painting and Decorating Contractors of America, 3913 Old Lee Highway, Suite 33 B, Fairfax, VA 22030.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINT APPLICATION GUIDE NO. 4

## Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems

### 1. Scope

**1.1** This Guide covers the steps necessary for the repainting of steel structures previously painted with oil base, alkyd, or other conventional oleoresinous paint systems with the same generic paint system as the existing one.

**1.2** When special paint systems such as zinc-rich, epoxy, or urethane are involved, spot tests may be necessary and the instructions of the manufacturer should be followed.

**1.3** The amount of maintenance cleaning and painting is determined by the need for corrosion protection and appearance and should be described in the procurement documents.

### 2. Description

**2.1** This Guide outlines the components of a complete maintenance repainting system. A standard system consists of surface preparation and repainting according to the guidelines presented in Table 1.

### 3. Reference Standards

**3.1** The standards referenced in this specification are listed in Sections 3.4 and 3.5 and form a part of this specification.

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

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

**3.4 SSPC AND JOINT STANDARDS :**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Paint Thickness with Magnetic Gages |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **SP 1** | Solvent Cleaning |
| **SP 2** | Hand Tool Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **VIS 2** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 610** | Evaluating Degree of Rusting on Painted Steel Surfaces |
| **D 3359** | Measuring Adhesion by Tape Test |

### 4. Surface Condition and Preparation

**4.1 SURFACE CONDITION:** The surface condition of the previously painted steel substrate should be classified and repainted in accordance with the applicable section of Table 1.

It is recognized that in any maintenance painting project, the structure or equipment to be repainted may have areas where the condition of the old paint work varies. In these cases each particular section of the area to be repainted should then be recoated in accordance with the applicable section of Table 1.

**4.2 SURFACE PREPARATION:** The SSPC Preparation Specifications should be followed as in Table 1, or with the mutual agreement of both owner and contractor, another set of surface preparation criteria may be established.

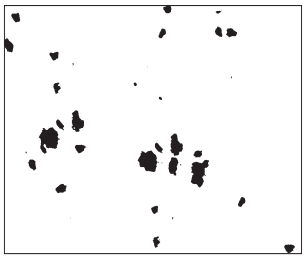
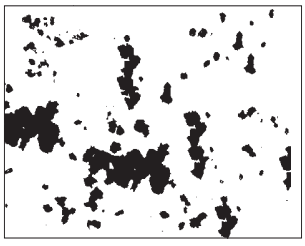
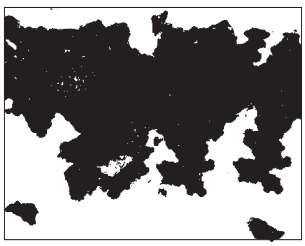
### 5. Paints

**5.1 PAINT SYSTEMS:** The wash primer (if any), primer, intermediate, and finish coat should be the same as those specified in the original paint system. Alternatively, a paint having the same generic type of vehicle as in the original painting may be used. Some other compatible paint system may be used if mutually agreed upon between the owner and contractor.

**5.2 COMPATIBILITY—SPOT TEST:** If the composition of the original paint system is unknown, a spot test should be made to determine the compatibility of the new system with the old, and should include: assuring the adhesion of the present system to the substrate; applying proposed painting system; and observing for adhesion, lifting, bleeding, or other evidence of incompatibility.

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**
**MAINTENANCE PAINTING OF OIL BASE OR ALKYD PAINTING SYSTEMS**

| PAINT SYSTEM CONDITION | RUST GRADES* | EXAMPLE OF AREA % (Generally Dispersed Rust) | CLEANING AND PAINTING RECOMMENDED |
|---|---|---|---|
| NON-DETERIORATED<br>(0 to 0.1% rust)<br>Paint almost intact; some primer may show, rust covers less than 0.1% of the surface. | 10-8 |  | Solvent clean (SSPC-SP 1) entire repaint area, and spot prime, if necessary. If required to maintain film thickness or continuity, spot apply finish coat, then apply 1.5-2.0 mils (36-51 micrometers) of finish coat over entire repaint area. |
| SLIGHTLY TO MODERATELY DETERIORATED:<br>(0.1 to 1% rust)<br>Finished coat somewhat weathered; primer may show slight staining or blistering; after stains are wiped off, less than 1% of area shows rust, blistering, loose mill scale, or loose paint film. | 8-6 |  | Spot clean (minimum SSPC-SP 2, hand tool cleaning) entire repaint area, and spot prime. If required to maintain minimum film thickness or continuity, spot apply finish coat, then apply 1.5-2.0 mils (38-51 micrometers) of finish coat over entire repaint area. |
| DETERIORATED:<br>(1 to 5% rust)<br>Paint thoroughly weathered, blistered, or stained, up to 10% of surface is covered with rust, rust blisters, hard scale or loose paint film, very little pitting visible. | 6-4 |  | Spot clean (minimum SSPC-SP 2, hand cleaning) entire repaint area, feather edges and spot prime. If required to maintain film thickness or continuity, spot apply finish coat, then apply 1.5-2.0 mils (38-51 micrometers) of finsh coat over entire repaint area. |
| SEVERELY DETERIORATED<br>(10 to 50% rust)<br>Large portion of surface is covered with rust, pits, nodules, and non-adherent paint. Pitting is visible. | 4-1 |  | Spot clean (minimum SSPC-SP 6, commercial blast cleaning) entire repaint area, feather edges and spot prime. If required to maintain film thickness or continuity, spot apply finish coat, then apply 1.5-2.0 mils (38-51 micrometers) of finish coat over entire repaint area. |
| TOTALLY DETERIORATED<br>(over 50% rust) | 1-0 |  | Clean (minimum SSPC-SP 6, commerical blast cleaning) entire repaint area and apply primer, intermediate, and finish coats over entire repaint area. |

*See SSPC-VIS 2 for pictorial representation of rust classification. Area percents illustrated here are representative only.

Provided by : www.spic.ir Licensee: NISOC Library

## 6. Paint Application

**6.1 PAINT APPLICATION:** Painting should be performed in accordance with Table 1 and the requirements of SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel."

**6.2 TOUCH-UP PAINTING:** After cleaning the previously painted steel surfaces, those areas with bare steel exposed should be spot primed in accordance with the "Field Painting" Section of SSPC-PA 1.

**6.3 DRY FILM THICKNESS OF PAINT SYSTEM:** Not less than the following as measured in accordance with SSPC PA 2, "Measurement of Dry Paint Thickness with Magnetic Gages"—the total dry film thickness at any point should not be less than 5.5 mils (140 micrometers). This means that areas of cleaned bare steel will require 1.5-2.0 mils (38-51 micrometers) of primer, 1.5-2.0 mils (38-51 micrometers) of intermediate coat, and 1.5-2.0 mils (38-51 micrometers) of finish coat.

## 7. Inspection

**7.1** 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 procedure specified by the American Arbitration Association shall be used.

**7.2** Samples of paints used under this painting system should be supplied upon request along with the supplier's name and identification for the materials.

**7.3** Unless otherwise specified, the methods of sampling and testing should be in accordance with Federal Test Method Standard No. 141, or applicable methods of the American Society for Testing and Materials.

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

## 8. Safety

**8.1** All safety requirements stated in this specification and its component parts apply in addition to any applicable federal, state, and local rules and requirements. They also shall be in accord with instructions of the paint manufacturer and requirements of insurance underwriters.

**8.2** Paints are hazardous because of their flammability and potential toxicity. Proper safety precautions shall be observed to protect against these recognized hazards. Safe handling practices are required and should include, but not be limited to, the provisions of SSPC-PA Guide 3, "A Guide to Safety in Paint Application."

## 9. Notes

**9.1** While every precaution is taken to insure that all information furnished in SSPC guides is as accurate, complete, and useful as possible, SSPC cannot assume responsibility or incur any obligation resulting from the use of any materials, paints, or methods specified therein, or of the guide itself.

**9.2 INSPECTION AND REPAIR:** It is most desirable to maintain paint systems by a scheduled inspection and repair procedure. In this manner, the life of the coating is prolonged through preventive maintenance which includes spot cleaning and spot painting when necessary. Although it is impossible to set down specific rules that should govern the repainting intervals or time, Table 1 is a summation of current good practice. Since the deterioration of paint is not uniform over an entire structure, the engineer in charge must use his own discretion in the application of such standard practices.

**9.3 MAINTENANCE PAINTING:** In maintenance painting it is not ordinarily intended that sound, adherent old paint be removed unless it is excessively thick or brittle or is incompatible with the new paint. It is essential, however, that the removal of deteriorated paint be carried back around the edges of the spot or area until an area of completely intact and adherent paint film, with no rust or blisters underneath, is attained. Testing should be in accordance with ASTM D 3359. Edges of tightly adhered paint remaining around the area to be recoated must be feathered, so that the repainted surface will have a smooth appearance.

**9.4 PREFERRED REPAINTING PROCEDURE:** The preferred repainting procedure is to spot clean only the deteriorated areas and apply a coat of rust inhibitive primer followed by an intermediate coat to build those areas back to a satisfactory level. Then apply an overall finish coat to the entire structure or repainted area.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# PAINTING APPLICATION GUIDE NO. 5

## Guide to Maintenance Painting Programs

### 1. Scope

**1.1** This Guide covers procedures for planning and carrying out a maintenance painting program for steel and other structures. The Guide may be used for one-time repaint programs or long-range repaint programs.

**1.2** The Guide is intended to be used primarily by owner's representatives.

### 2. Description

**2.1** Maintenance painting of structural steel is required to prevent corrosion and to maintain appearance. Decisions on frequency and extent of repainting and type of system to be used require consideration of numerous factors and alternatives.

**2.2** This Guide sets out specific tasks as summarized in 2.3, which may be used individually or collectively to identify and answer key points in maintenance painting.

**2.3 MAJOR TASKS IN MAINTENANCE PAINTING:**

| | |
|---|---|
| **Task 1** | Define Maintenance Painting Objective (Section 5) |
| **Task 2** | Plan and Conduct Condition Assessment (Section 6) |
| **Task 3** | Determine Corrective Action Required (Section 7) |
| **Task 4** | Establish Procedures for Corrective Action (Section 8) |
| **Task 5** | Prepare Contract (Section 9) |
| **Task 6** | Secure Contracts for Labor and Materials (Section 10) |
| **Task 7** | Monitor, Conduct, and Inspect Repainting (Section 11) |
| **Task 8** | Plan and Implement Follow-Up Activities (Section 12) |

### 3. Reference Standards

3.1 The standards referenced in this guide are listed Sections 3.3 and 3.4 and form a part of this specification.

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

**3.3 SSPC AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Paint Thickness with Magnetic Gages |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **SP 1** | Solvent Cleaning |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 11** | Power Tool Cleaning to Bare Metal |
| **VIS 2** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |

**3.4 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 610** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |
| **D 5043** | Field Identification of Coatings |
| **D 3359** | Measuring Adhesion by Tape Test |
| **D 4541** | Pull-Off Strength of Coatings Using Portable Adhesion Testers |

**3.5 NACE STANDARD:**

| | |
|---|---|
| **RP-01-72** | Surface Preparation of Steel and Other Hard Materials by Water Blasting Prior to Coating or Recoating |

### 4. Planning and Use of Guide

**4.1** Planning and implementation of maintenance painting programs for steel structures are presented in a logical sequence of eight specific tasks. These tasks range from defining the program objectives to follow-up activities required to implement an ongoing maintenance program.

Provided by : www.spic.ir Licensee: NISOC Library

Each task is designed such that it may be utilized as stand-alone for those with interest in only one or a few aspects of the program. A summary of the tasks is as follows:

**4.1.1 Task 1: Define Maintenance Painting Objective.** This section emphasizes the need for a written objective for maintenance painting and identifies several commonly used objectives and how they are affected by timing and economics.

**4.1.2 Task 2: Plan and Conduct Condition Assessment Survey.** This section provides a general approach for organizing surveys to evaluate the condition of the structure. Three different types of surveys (general overview, detailed visual survey, and physical inspection) are covered, along with a proposed plan for assessing subunits of a larger, more complex structure and a description of procedures and documentation needed.

**4.1.3 Task 3: Determine Corrective Action Required.** This portion reviews the various corrective actions available, including deferring maintenance, spot repair, and complete repaint, the rationale for selecting these options, and types of information needed for the decision.

**4.1.4 Task 4: Establish Procedures for Corrective Action.** This portion reviews the factors and considerations necessary to establish specifications for the two major options of spot repair and complete repaint. Procurement procedures are also reviewed.

**4.1.5 Task 5: Prepare Contract.** This portion reviews the major sections of a contract and other contractual matters such as format, contractor qualifications, and owner/contractor relations.

**4.1.6 Task 6: Secure Contracts for Labor and Materials.** This portion describes the steps and considerations in scheduling and awarding contracts, including pre-bid conferences.

**4.1.7 Task 7: Monitor, Conduct, and Inspect Repainting.** This task describes major activities that occur during the actual execution of the contract, including inspections before, during and after the work, and review of procedures and contingencies.

**4.1.8 Task 8: Plan and Implement Follow-Up Activities.** This task describes what needs to be done after the job is completed, including documentation, short- and long-term condition inspections, and preventative maintenance measures.

## 5. Task 1: Define Maintenance Painting Objective

### 5.1 DEFINE OBJECTIVE:

5.1.1 The first, and perhaps most important, step in developing a maintenance painting program is to define the objective of the program. Careful, up-front consideration of the program's goals will facilitate further planning and decision making as the program develops. Everyone involved in developing a maintenance painting program has an objective, often only in his mind or expressed verbally. It is desirable to state the objective(s) in writing so that all persons concerned with the program have a common understanding and agreement. Without a stated objective or goal, measurement of the success of a maintenance painting program is nearly impossible.

**5.1.2** In developing a statement of objectives for a maintenance painting program, consideration needs to be given to several key factors, including (a) the purpose for the maintenance painting program, (b) the time frames involved and (c) the economics of the program.

### 5.2 PURPOSE OF MAINTENANCE PAINTING:

**5.2.1** Maintenance painting of public and private structures and facilities is undertaken for a number of specific purposes. Often, multiple purposes are served by painting. Two major purposes are (1) protection against corrosion or other forms of deterioration and (2) improvement of the appearance or aesthetics of the structure or facility. Other purposes, such as safety/identification and energy conservation, may be important as well. Each of these purposes will be discussed briefly:

**5.2.2 Protection:** Protection against corrosion and loss of structural integrity is often the primary purpose of maintenance painting. This is especially true for steel structures located in or near chemical processing plants, near the seacoast, or in other corrosive environments. Bridges subject to deicing salts and structures frequently wet by rainfall, dew or water from man-made sources also require special consideration for corrosion protection. A maintenance painting program should strive to correct deficiencies that resulted in previous failure. If protection is of primary importance, and aesthetics are of secondary or no concern, this should be indicated in the statement of objective as it will affect numerous decisions in the maintenance painting program.

**5.2.3 Appearance:** When structures are exposed to public view or are a part of employees' working environ-

Provided by : www.spic.ir Licensee: NISOC Library

ment, appearance is usually a factor in planning and executing a maintenance painting program. For certain structures, maintenance of appearance may be the primary or only purpose for painting. The desire to maintain an attractive appearance can materially affect frequency of painting, type of coating employed, and color selection. Color fading, chalking, checking and rust-staining are often only cosmetic problems. They may be reasons for repainting when the purpose is maintaining appearance, but would be of minor concern when protection is the sole or primary consideration.

**5.2.4 Safety/Identification:** Public safety, or the protection of employees and visitors is sometimes a key purpose of maintenance painting. Often such painting requirements are dictated and controlled by government agencies. An example is the requirement of the Federal Aviation Administration (FAA) that towers, elevated tanks, stacks and other high structures located in airport flight patterns be painted with white and orange stripes or a checkerboard pattern. The Occupational Safety and Health Administration (OSHA) requires safety color coding of in-plant hazards, handrails, fire protection equipment, and first aid stations. Nonskid deck coatings and roadway striping are other examples of painting for safety. Pipes and tanks are often painted with color-coding systems to identify contents and facilitate process control. White or light colored paints are used to improve visibility in tunnels or viaducts. When safety or identification is one of the purposes of maintenance painting, such factors as repaint frequency and topcoat color selection are often impacted.

**5.2.5 Energy Conservation:** Additional purposes for maintenance painting may exist in special situations. An example would be painting the exterior of a storage tank white that contains volatile liquids to reduce heat buildup from infrared rays of the sun and thus reduce evaporative loss of product. Similarly, metal building roofs may be painted white to reduce air conditioning costs. Conversely, tanks containing viscous liquids may be painted black to maximize heat absorption, thereby maintaining fluidity and reducing the need for external heat sources.

**5.3 TIMING CONSIDERATIONS IN DETERMINING OBJECTIVES:**

**5.3.1** Time frames will often affect the statement of objectives for a maintenance painting program. These timing issues may relate to the timing or duration of the painting program itself, to time restrictions on the painting operation, or to the anticipated useful life of a structure.

**5.3.2** A maintenance painting program can be small in size and short in duration, such as a program to paint an individual structure at a specific time. Programs of intermediate size might involve a one-or two year program to repaint a group of structures or an entire facility. Longer-range, broader scope programs may involve a 5-, 10-, 20-year or perpetual program for an entire agency, division, or corporation. Severe time restrictions may be placed on the planning and execution of maintenance painting during plant shutdown. Finally, it would make little sense to apply a 20-year paint system on a structure which is scheduled for dismantling and scrapping in three years.

**5.4 ECONOMIC CONSIDERATIONS:**

**5.4.1 Availability of Funds:** By necessity, economics are a key consideration in determining maintenance painting objectives. Cost factors and the availability of funds will have a major impact in setting the objectives. At either extreme of funding, objective setting would be simple. With unlimited funds, the painting objective could be "perfection." Without funds, maintenance painting objectives become meaningless. In reality, available monies fail somewhere between none and unlimited.

**5.4.2 Alternative Approaches:** There are basically two approaches that can be taken when considering economic issues in developing objectives. One is to first determine funds available and then develop objectives consistent with that level of funding. The other is to develop the objectives and then estimate the funding levels required to achieve that objective. When developing a maintenance painting program, it is often desirable to consider several objectives and then develop cost estimates for achieving each. Thus several alternative plans for varying levels of protection/appearance can be developed, each with its own associated cost. Providing alternatives facilitates management decisions.

**5.5 ENVIRONMENTAL CONSIDERATIONS:** A maintenance painting program should recognize the desirability of protecting the environment (air, ground, and surface water), and the need to comply with specific environmental regulations.

## 6. Task 2: Plan and Conduct Condition Assessment Survey

**6.1 IDENTIFY STRUCTURES TO BE SURVEYED:** A written description of the structure should be obtained or prepared and should include location, dimensions, type of substrate, configuration, process (if applicable), painting history (if known), and any other pertinent information. Examples of the latter would include proximity to sensitive areas, planned new construction or other activities nearby, and types of exposures (e.g., acid fallout).

**6.2 DETERMINE TYPE OF SURVEY REQUIRED:** The survey may vary considerably in the extent and detail of the information required. Among the types to be considered are:

Provided by : www.spic.ir Licensee: NISOC Library

**6.2.1 General Overview Coating Survey:** In this survey, usually only one or two parameters are rated, (e.g., general condition or rusting). The structure is normally observed from the ground (i.e., without scaffolding). The survey produces at best a qualitative rating of the condition (e.g., good, fair, poor). Only the major features of a structure or facility are rated (e.g., a full span of a bridge or a side of a storage tank). This type of survey is usually done in a few hours or less and is suitable for distinguishing severe condition trends.

**6.2.2 Detailed Visual Survey:** This type of survey also relies exclusively on visual observations, but these are done more systematically than for a general overview survey. Numerous structural elements (e.g., support beams, connections, edges) are separately rated and combined to provide an overall structure or facility rating. Often, several condition parameters (e.g., loss of topcoat, cracking, rust staining), and several corrosion parameters (e.g., rusting, blistering, scaling, loss of metal) are recorded. With this survey one can obtain a semiquantitative rating of the percent of surface deteriorated. This type of survey may assist owners to develop preliminary cost estimates for the repainting.

**6.2.3 Physical Coating Inspection:** Physical inspection is often carried out along with visual inspection and general survey. The above visual rating gives no information on the film adhesion, thickness, brittleness, or underfilm corrosion. Physical inspection requires direct access to the surface at several locations on the structure. It requires some simple tools such as knife, adhesion test kit, dry film thickness (DFT) gage, or Tooke gage. Probably the most important parameters to measure are the dry film thickness and the adhesion. The DFT should be measured in a number of locations to obtain averages at each location in accordance with SSPC-PA 2. In some instances a Tooke Gage may be used to determine the number of coating layers applied. The most commonly used adhesion test is the tape adhesion test (Method A, crosscut adhesion test or Method B, knife test of ASTM D 3359), although tensile adhesion testers are also used (ASTM D 4541). The adhesion rating should also be taken at numerous locations with several readings taken at each location to provide a statistical average. The physical inspection is frequently necessary to determine whether the paint can be overcoated or repaired, or whether it is too brittle to accept another coating layer. Identify any areas of severe corrosivity and record dimensions. Measure the depth of corrosion pits with a pit gage. When the presence of chloride or other soluble salts is suspected, the surface should be tested for their presence.

**6.2.4 Structural Inspection:** Coating inspection may be included as part of a general structural inspection for loss of metal, broken joints, or other structural defects. Separate contracts should be prepared and issued for structural repairs and this work performed by others.

**6.3 DETERMINE CONDITION RATING SCHEME:** For both visual and physical inspection it is necessary to specify the types of conditions and damages that will be identified in the rating.

**6.3.1 Visual Conditions:** Visual defects that can be rated include erosion of topcoat, erosion or undercutting of primer, pinpoint rust, general rust, and severe corrosion. These conditions can be evaluated and rated in several ways:

a. Percent estimation of surface damaged (i.e., eyeball or mental computation of this percent).

b. Comparison to visual standard (e.g., use of numerical rating scales such as SSPC-VIS 2 which has a rating scale of 0 to 10 with 10 representing a perfect rating).

c. Comparison to photographs, such as illustrations of degrees of breakdown of different portions of a composite bridge structure.

d. Quantitative measurement of percent area degraded by manual or automatic image processing techniques.

e. For visual inspections it is useful to retain photographs of the structure with dates as a part of the record.

**6.3.2** Written descriptions or criteria should be provided for each rating. For example, the following is a suggested set of conditions for evaluation of deterioration of the coating system, and specific surface preparation and recoating procedures can then be designated for each of these conditions:

**Condition 1. Reduced Film Thickness:** Erosion of film thickness due to weathering and UV exposure as evidenced by initial changes in gloss characteristics and eventual "shadowing" or areas of primer being exposed.

**Condition 2. Topcoat Deterioration:** Normal deterioration mostly due to embrittlement of topcoat film with cracking, crazing, and eventual delamination from primer.

**Condition 3. Edge Rusting:** Corrosion breakthrough at edges, primarily edges of flanges of structural steel, but also any irregular surface or design condition that permits localized rusting. Measured as a percent of lineal feet.

**Condition 4. Plane Rusting:** Substantial rusting occurring on surface area such as webs and flange faces of structural members, and relatively flat surfaces such as tank exteriors. A high percentage of rusting at this level generally indicates inability of substrate to withstand continued exposure and general failure of coating system.

**Condition 5. Severe Corrosion:** Situations of heavy contamination of steel, severe attack of coating and possible metal loss including: localized attack by corrosive agents, corrosion scale (stratification), rust nodules (tubercles), pitting, delamination, and/or undercutting of entire coating system.

Provided by : www.spic.ir Licensee: NISOC Library

**6.3.3 Physical Inspection:** Where possible, numerical values should also be assigned to these ratings. The ASTM Methods D 3359 and D 4541 provide numerical ratings for adhesion. Other physical properties such as hardness (e.g., scratch hardness as determined by a knife or hardness determined by a coin rub) and resistance to undercutting (usually a knife) may be more difficult to quantify.

**6.3.4 Use of Ratings Data:** In many cases, these condition ratings will be keyed directly to repair procedures (i.e., SSPC-PA 4). The next two sections of this guide (Tasks 3 and 4) give the procedures for developing such a scheme.

**6.4 PLAN FOR INSPECTING STRUCTURAL COMPONENTS:**

**6.4.1** A subunit sampling plan identifies which portion of the structure or facility will be rated and the type of rating scheme to be used. Such a plan is needed for a complex structure or where detailed information is required. For a process unit (for example) the structural steel might be divided into individual tanks, piping, handrails and ladders, and structural support. For larger vessels, one could subdivide based on the sides or portions of the structure. Because of differences in corrosion tendencies, it is often useful to have separate ratings for edges and planes. The extent of sampling depends on how detailed a survey is desired and what resources may be available.

**6.4.2** Condition assessments can be used for several purposes, i.e., to determine the need for repainting; to determine the extent of corrosion and corrosion damage; or to determine the performance of various paint systems. It requires a relatively small additional inspection time to evaluate and record the ratings of individual structures or structural elements. This information will normally prove extremely valuable in evaluating maintenance options.

**6.5 ESTABLISH PROCEDURES AND DOCUMENTS:**

**6.5.1** A specific procedure should be established for a condition assessment. The assessment will require a budget, as the availability of funds will determine the extent of survey that can be undertaken. A schedule should be established based on the number of hours or days required to prepare the structure (e.g., notify other trades) or arrange for access (i.e., coordinate schedules of other individuals). This includes identifying support crews and equipment that may be required to assist with the condition assessment.

Required standards (e.g., ASTM standards or other criteria) as well as field equipment (tape recorders, inspection forms, etc.) must be available. Personnel requirements must also be established (which individuals will conduct the survey). These can be in-house inspectors, engineers, outside consultants, painting contractors, or paint manufacturers. For a survey to be performed by a consultant or contractor, a written contract for the survey should be prepared. If a manufacturer offers to do it at no cost, he should be asked to submit a written description of his plan for the agency's prior review and modification.

**6.6 CONDUCT SURVEY:** A survey should then be conducted in accordance with the foregoing procedures and information. The owner's representative should ensure that all elements of the survey have been properly carried out and that the information is properly recorded and distributed to those who have a need to know the results.

## 7. Task 3: Determine Corrective Action Required

**7.1 REVIEW SURVEY DATA AND PAINTING OBJECTIVES AND CRITERIA:**

**7.1.1** The corrective action to be taken (if any) is based on the results of the previous surveys, the short- and long-term objectives of the painting program, and special limitations or other relevant factors.

**7.1.2** The data to be analyzed is that which has been previously collected from an overview, visual or physical inspection. Typical condition ratings are given in Section 6.3.1. If no formal survey was taken, one must use the best information available (e.g., paint historical records) to estimate the overall condition ratings.

**7.2 DECIDE AMONG ALTERNATIVE OPTIONS:** Having reviewed the data, one turns to a consideration of the alternative actions available. These range from no painting at all to complete paint removal and repainting.

**7.3 NO MAINTENANCE REQUIRED FOR TWO YEARS OR LONGER:** This option is favored under the following circumstances:

**7.3.1** Paint on structure is in good to excellent condition.

**7.3.2** Structure is in mild environment and little corrosion activity is expected even at breaks in the paint film over the next few years.

**7.3.3** The decline and appearance due to minor discolorations or topcoat erosion or paint degradation is not very important, due to the locations on the structure. In general, the coating is intact and protection is still being provided.

**7.3.4** Structure is being assigned a low priority for maintenance because of economics, aesthetics, or other reasons.

Provided by : www.spic.ir Licensee: NISOC Library

**7.3.5** The structure is scheduled for a major repaint, including blast cleaning within two years; the additional time is not expected to add significantly to the corrosion metal loss or the surface preparation cost.

**7.4 SPOT REPAIR ONLY:**

**7.4.1** Spot repair entails surface cleaning of isolated corrosion or paint breakdown areas either by hand/power tool cleaning, pressurized water jetting, or abrasive blast cleaning. The intact paint surrounding the degraded area must be feathered back to allow for a smoother appearance and better topcoat adhesion. The cleaned areas are primed with a paint compatible with the existing paint system and overcoated to conform with required DFT. In this particular option, the remaining (e.g., intact) paint is not overcoated. It should be noted that the spot repair method is primarily a stopgap method; it is recommended that the structure be reevaluated within three to five years.

**7.4.2** This option would be favored under the following circumstances.

**7.4.2.1** Repairs are hidden or in low visibility area are thus unimportant to the aesthetics.

**7.4.2.2** Agency maintenance crews are available for that type of work.

**7.4.2.3** Structures are small, not requiring extensive scaffolding or hard-to-access areas.

**7.4.2.4** Corrosion and degradation are limited to isolated areas and relatively small sections which amount to less than 1% of total area.

**7.4.2.5** Decision has been made to upgrade small isolated areas such as bearing areas, crevices, or areas subject to leakage or condensation or chemical splash.

**7.5 SPOT REPAIR PLUS FULL TOPCOAT:**

**7.5.1** This technique is similar to Section 7.4 with the addition of a full finish coat over the entire surface, including spot repaired areas and the intact paint areas. This would also require feathering of the repainted areas into the unpainted areas and assurance that the topcoat was compatible with the existing paint. This type of system would be expected to give additional life (perhaps five years or more) to the entire surface area. It would help prevent further deterioration of the intact paint and reduce the likelihood of requiring full coating removal in the future.

**7.5.2** This approach is favored under the following circumstances.

**7.5.2.1** The existing paint is in relatively good condition and still resilient and does not have excessive film build (e.g., not above 15 mils [381 micrometers]).

**7.5.2.2.** Structure access is relatively difficult.

**7.5.2.3** Intact surface can be readily cleaned with pressurized air, water (NACE RP-01 72), hand tool (SSPC-SP 2) or power tool cleaning (SSPC-SP 3) or solvent or detergent wiping (SSPC-SP 1).

**7.5.3** If severely corroded surfaces were found under 6.2.3, special cleaning methods and coating systems may be required.

**7.6 COMPLETE REPAINT OF STRUCTURE OR SUB-UNITS:** When the paint condition is poor or bad and when funds are available, a decision to repaint the structure in its entirety is usually made. This involves removing the old coating and all of the corrosion product before applying the primer, intermediate coats, and topcoat. Painting a sub-unit of a structure may be a variation of this alternative when funds are short or when the remaining portions of the structure are in good condition.

**7.7 OTHER REPAIR METHODS:** On occasion, special methods or combining of treatments will be required. A higher quality coating system (e.g., abrasive blast cleaned with zinc-rich/epoxy/urethane) may be required for high corrosion areas of a structure (e.g. areas subject to deicing salt, dripping or chemical spillage), with a less expensive system (e.g., hand tool cleaning with good wetting high-solids epoxy or alkyds) on less critical or corrosion-prone areas. Topcoats may be required to blend in with restored or rehabilitated portions of the structure.

**7.8 ADDITIONAL SURVEY:** In some cases, after analyzing the available data, it may be concluded that an additional survey is required, since the initial survey may have been too abbreviated to provide meaningful data. In other cases, the survey may have only looked at a portion of the structure or not examined some specific details required, such as the integrity of the paint near highly corrosion prone areas. The area may be scheduled for other repair or outage work within the two-year period, and will be reassessed at that time.

## 8. Task 4: Establish Procedures for Corrective Action

**8.1** Once a course of action has been determined, it is essential that detailed specifications and other documents be prepared to achieve that course of action.

**8.2 IDENTIFY RELEVANT FACTORS FOR PAINTING SYSTEM SELECTION:**

Provided by : www.spic.ir Licensee: NISOC Library

**8.2.1** The selection of the painting system is influenced not only by the type of repainting (e.g., spot repair or complete repaint) but also by special factors such as restrictions due to environmental health and safety regulations, budgets, exposure environment, weather, or configuration. Thus, before choosing the painting system, it is useful to identify these pertinent factors.

**8.2.2** Abrasive blasting may be restricted due to air quality concerns or the need to avoid dust or abrasive rebound in sensitive areas. The presence of lead-containing paint on a structure may require special collection and containment devices or dictate the use of a spot repair type maintenance. Regulations on the volatile organic compound (VOC) content may exclude the use of standard and commonly used coatings.

**8.2.3** Weather or configuration can also limit the selection of painting systems. Many coatings (e.g., conventional epoxies, waterborne acrylics) cannot be applied below 50 °F (10 °C). Other paints are sensitive to high humidity or low humidity (e.g., inorganic zinc-rich primers). In certain configurations, spray application may not be permitted because of high wind, overspray on sensitive equipment or automobiles, Guide may be used for onetime repaint programs or long-range repaint programs.

**8.2.4** The exposure environment is a major determinant of the painting system. Typically exposure environments are classified according to the presence of salt, pollution, rain/humidity, or chemicals. (See Note 14.1.)

**8.2.5** The specifier must also be aware of the existing condition of the structure. For spot repair or partial repaint, the compatibility of the new coats over existing ones should be verified (see Appendix A). Even where blast cleaning, it is important to recognize that non visible contaminants (e.g., chlorides or sulfates) which may remain on the surface after blast cleaning can have significant effects on coating system life (Note 14.5). The following paragraphs describe the general selection process for the various options identified in Section 7.

**8.3 PREPARE PROCEDURES AND SPECIFICATIONS FOR COMPLETE REPAINT:**

**8.3.1 Select/Identify Painting System:**

**8.3.1.1** For complete repaint, one assumes that the entire existing system will be removed by abrasive blast cleaning or other similar technique. The coating system selected should be one which is designed to be applied over blast cleaned steel, with the precautions noted in 8.2.5 about soluble salts remaining on the surface. The painting system includes the method of surface preparation, the individual paint layers (primer, intermediate, topcoat), the film thicknesses, and the method of application.

**8.3.1.2** Available surface preparation techniques for complete repainting include conventional (dry) abrasive blast cleaning, wet abrasive blast cleaning, vacuum blasting, and pressurized water jetting. Normally this latter method requires sand or abrasive injection to effect complete removal of existing rust scale and paint and to add a profile. An important consideration in blast cleaning is the disposal of the abrasives and paint residue, particularly if paint contains lead or other potentially hazardous materials. In some cases, however, where the above surface preparation techniques cannot be used, it may be necessary to apply a full coating system (primer, intermediate and topcoat) over a surface which is not rust and paint free. Certain power tools are also capable of removing existing rust and paint but generally at much lower production rates. For surface preparation, it is important to specify the degree of cleanliness and the surface profile (for blast cleaning), and the need for solvent cleaning prior to blast cleaning. SSPC and other organizations have well-defined standards for most of these requirements, which can readily be incorporated into a specification. Guides are being prepared by SSPC for containment and disposal of paint and abrasive waste.

**8.3.1.3** The application methods are normally governed by the materials selected and are designated by the paint manufacturer on their data sheets. SSPC-PA 1 provides guidance for contractors and will supplement the manufacturer's application instructions.

**8.3.2 Select Paint Materials**

**8.3.2.1** There is an enormous variety of paint materials which are designed for application to clean steel, and each organization or agency will have its own means for selecting such systems. One of the most important factors in selecting a coating system for maintenance painting is the degree of success of previous systems under the exposure conditions. However, even a coating system which has given adequate protection in service may not be the best choice for maintenance because of restrictions on materials (e.g., solvents, pigments), unavailability of previous system, or reduction in cost of new systems. For maintenance painting, the following attributes should be considered:

a. Service history under similar conditions.
b. Application under (potentially adverse) field conditions
c. Application to structural configurations, often from difficult-to-access positions.
d. Complexity of requirements for field mixing.
e. Acceptable times for drying, overcoating or exposure to rain or cold.

Provided by : www.spic.ir Licensee: NISOC Library

f. Documented durability and protection afforded in specific exposure environments.
g. Ease of repair and touch-up.
h. Cost of materials and application.
i. Track record and reliability of supplier.
j. Capabilities and qualifications of contractor.
k. Potential environmental, safety or health hazards of paint materials.

**8.3.2.2** The selection of the painting system often involves two phases, first identifying the generic type (e.g., epoxy, zinc-rich, urethane, etc.), and second, identifying the criteria for selecting a proprietary material. The specification may utilize generic compositions, a qualified products list of proprietary materials, or other approaches.

**8.3.2.3** An important part of the specification is the paint film thickness. Both a minimum and a maximum dry film thickness should be specified, along with the method of measurement (e.g., SSPC-PA 2).

**8.3.3 Determine Inspection and Quality Control Requirements of Paint Materials:**

**8.3.3.1** In the paint specification, the owner should describe the procedures for qualification and acceptance criteria for the paint materials. For qualification, the supplier may be required to furnish evidence of previous use of the coatings on similar structures, or laboratory tests of physical properties, accelerated corrosion and weathering properties, and application properties. These properties should be certified by manufacturer or independent laboratory. For new technology coatings, extensive service data may not be available. The owner may also require some verification that the material delivered to the job site is the same as that which was originally qualified. Some general guidelines on acceptance sampling are given in Chapter 7.2 of SSPC Painting Manual, Volume I, "Good Painting Practice. "

**8.3.3.2** The end result of the above selections is a well-defined specification, which can be utilized by a manufacturer to prepare and submit coatings, and that can be incorporated into a procurement document or contract.

**8.4 PROCEDURES FOR SPOT REPAIR ONLY OR SPOT REPAIR PLUS FULL TOPCOAT:**

**8.4.1 Determine Condition of Existing Painted Surface:** One of the most important factors in selecting a system is the condition of the existing surface. The survey data will indicate the approximate portions which have rust or loose paint. However, it is often necessary to identify the specific type of paint as well as the identity, type, location, and approximate extent of paint defects or corrosion. A new ASTM procedure has been developed for field identification of generic paint types. There are also several common approaches to evaluating the condition of the existing paint. These involve simple adhesion tests such as the knife adhesion or tape adhesion test (ASTM D 3359). Visual rating methods are described in section 6.3.1. As noted previously, it is also important to identify surface contaminants (e.g., salts) which may be trapped under tightly adherent corrosion scale layers or present beneath a loose or under corroded paint film. If the paint and rust is not to be removed, then the salts will remain on the surface. The preceding checks and evaluations will normally require a field inspection or evaluation of the structure to be painted. In some cases, this may be covered during the survey, but it may also be necessary to reexamine the condition immediately prior to painting. This is particularly true if the contract will be priced according to the proportion of the surface that requires spot cleaning.

**8.4.2 Determine Techniques and Standards for Repair, Surface Preparation, and Repainting:**

**8.4.2.1** In a spot repair operation, certain portions of the structure are judged to require special preparation (i.e., spot repair). It is important that the techniques used to do these spot surface preparations be appropriate to provide a good surface for painting and that it not adversely affect the other areas. These other areas are generally those with existing intact paint.

**8.4.2.2** One important decision to be made is whether abrasive blast cleaning will be used for spot repair maintenance. If abrasive blasting is acceptable and affordable, the damaged areas will usually be spot blasted to remove all the rust and paint to achieve a commercial blast (SSPC-SP 6) or greater. The remaining areas of intact paint will then receive a brush-off blast to remove loose paint or other surface contaminants. The brush-off blast cleaning (or other method of scarification) may also be necessary to obtain acceptable adhesion between the intact paint and the repair system. Great care must be exercised when spot blasting to avoid over-blast damage to the adjacent intact paints. Spot blasting is generally not recommended for areas less than about one square foot or for more than 5 to 10% of the surface area.

**8.4.2.3** Alternatives to spot blasting include hand tool cleaning (SSPC-SP 2), conventional power tool cleaning (SSPC-SP 3), special profiling power tool cleaning (SSPC-SP 11), and vacuum blasting. These techniques are more suitable for small areas and are consequently more labor-intensive. When these techniques are used on the damaged areas, other more productive techniques may be required on the intact areas. One alternative is pressurized water jetting, which is capable of removing loose rust and mill scale under normal conditions, and, with prolonged dwell times, tight paint (NACE RP-01-72). At reduced pressures or distances it is also suitable for removing loose

Provided by : www.spic.ir Licensee: NISOC Library

paint and other debris from the large areas of intact paint. For most of the above techniques there are existing SSPC and other standards for the degree of cleaning or the methods used.

**8.4.2.4** After spot cleaning, the repaired areas are coated with a primer selected for its adhesion and protection over exposed metal or oxide and its compatibility with existing paint and subsequent full overcoats. The primer should be applied to a feathered edge where it overlaps existing paint to avoid edge lifting and other film discontinuities.

**8.4.3 Determining Painting Materials for Repainting:**

**8.4.3.1** The selection of the paints will be determined by the general restrictions and constraints and on the need for compatibility with the existing surfaces. Most paints are suitable for application to the bare metal areas (i.e., spot repaired areas), so the main concern is compatibility with previous paint. The determination of compatibility can be made by reference to compatibility charts (available from the Navy or from paint manufacturers) or by a specific compatibility test. A simple compatibility test is given in Appendix A. Compatibility tests may not be required if a material of similar generic properties is reapplied. An example is application of an oil or alkyd system over an existing oil-alkyd system. Specific techniques for this situation are given in SSPC-PA 4. Thermoplastic lacquers such as vinyls and chlorinated rubbers and most latexes can also normally be applied over a generically similar aged film.

**8.4.3.2** For chemically curing coatings such as two-component epoxies and urethanes, a compatibility test may be necessary to determine if scarification of aged coatings is required to achieve proper adhesion, even if the topcoat is to be the same generic type. Two factors which may cause compatibility problems are strong topcoat solvents and strong cohesive shrinking forces by chemically curing topcoats. The former is exemplified by vinyls or conventional high-solvent epoxies or urethanes. Highly cross-linked systems with high amounts of solvent can undergo considerable amounts of shrinkage with resultant forces that can lift the underlying coating system. Other causes of apparent "incompatibility" are salts, oils, or other contaminants on the surface prior to painting, or excess total film thickness. Chalking can also be a serious problem, particularly with waterborne coatings. Coatings applied over a chalked surface may not wet the surface well and cause topcoat delamination.

**8.4.3.3** The selection of the painting materials for spot repair is guided by the same considerations as for full repaint. For spot repair of small areas, a brushable primer is advantageous. It is also important that the primer be compatible with the existing intact paint because at the interface it is impossible to avoid applying primer over the intact areas. Thus, an organic zinc or high-solids epoxy would be preferred to an inorganic zinc for this application.

**8.4.3.4** The coatings selected for the full topcoat must of course be compatible with both the spot primer and the existing intact paint.

**8.4.3.5** The requirements for application, film thickness, material qualifications, acceptance criteria, are the same as those for applying a full repaint system. For spot repair, however, it is essential that the requirements for determining which areas are to be repaired should be clear and definitive. The specification should identify pictorial standards or photographs or physical inspection techniques (e.g., use of dull putty knife to determine if material is loose) and should specify who has responsibility for making final determination of which areas receive which treatment. Discussion of these items should also be included in the pre-bid and pre-job meetings (Sections 10.3 and 10.5).

**8.5 DEVELOP PROCEDURES FOR PROCUREMENT, STORAGE, AND DISPOSAL OF PAINTS:** Most agencies have formalized procurement policies which must be observed when procuring paint. The manufacturer and the application contractor can also assist in developing the above procedures. Among the items required in the procurement document are the following:

**8.5.1 Identification of Type of Specification** (composition, qualified product list)

**8.5.2 Identification of Procuring Agent** (structure owner, including title and department, contractor)

**8.5.3 Method of Procurement** (procured and stocked by owner, ordered separately for each job)

**8.5.4 Purchase Order Responsibility**

**8.5.5 Paint Packaging Requirements** (sizes of container, labelling requirements)

**8.5.6 Information Required from Manufacturer** (application instructions, materials safety data sheet, shipping requirements)

The owner should ascertain that these requirements are included in the procurement document. It is also valuable to have the name of a manufacturer's representative in case there are questions or disputes about the quality or compliance of the paints.

**8.5.7 Procedures for Shipping of Paints and Jobsite Storage of Paints:** Shipping should be done in accordance with the requirements of the U. S. Dept. of Transportation.

Provided by : www.spic.ir Licensee: NISOC Library

It is primarily the shipper's responsibility to furnish labels and insure compliance with the above regulations; however, the user or receiver of the paints must be cognizant of these regulations and refuse to accept non-confirming material.

**8.5.8 Procedures for Disposal of Paint:** Responsibility (i.e., contractor or owner) should be specified along with any specific owner requirement and relevant EPA procedures.

**8.5.9 Inventory:** Inventory should be kept of all materials, including number of gallons, product code, batch number, manufacturer, and date of manufacture.

**8.5.10 Acceptance Testing:** The purchaser of paints is also normally responsible for conducting acceptance testing to ensure that the manufactured product meets specified requirements. A discussion of tests and procedures for acceptance testing is given in Chapter 7.2 of Volume 1 of the SSPC Painting Manual (Note 14.1). This includes both acceptance sampling from containers or vessels and acceptance testing of liquid paints. Samples of paints should be retained for future reference.

## 9. Task 5: Prepare Contract

**9.1 IDENTIFY BENEFITS:** A well planned and designed contract will benefit both the owner and the contractor as follows:

**9.1.1** Reduce the cost of the work to the owner.

**9.1.2** Avoid confusion during the course of the work over what was originally intended.

**9.1.3** Eliminate unnecessary contingencies for the contractor.

**9.1.4** Provide for a smooth trouble-free work flow without costly interruptions.

**9.1.5** Identify and anticipate possible problems, avoid them when possible, and provide means to resolve them when they occur.

**9.1.6** Complete the work safely.

**9.2 ESTABLISH QUALIFICATION REQUIREMENTS FOR CONTRACTORS:**

**9.2.1 Pre-Qualification of Contracting Firms:** Numerous owners require that a contractor be bonded to cover the estimated cost of the work. A few agencies have adopted guidelines or procedures for screening or prequalifying contractors, based on references or actual job evaluations.

**9.2.2 Qualifications for Applicators and Blasters:** A few state and other agencies require that the applicators demonstrate their abilities to attain specified quality of cleaning and coating application.

**9.2.3 Union or Labor Requirements:** Some jurisdictions may be restricted to union shops.

**9.3 PREPARE RELEVANT CONTRACT SECTIONS:**

**9.3.1 Reference Standards:** A list of all applicable technical standards which apply to the work should be included.

**9.3.2 Scope of Work:** Provide a detailed list of all facilities to be recoated/repainted. Explicitly identify work boundaries. Facilities (buildings, equipment, pipelines. tanks, etc.) not listed will not be recoated/repainted under the contract.

**9.3.3 Coating System:** Identify the coating systems to be used. Group systems by the appropriate substrate identifying composition (e.g., carbon steel), current condition (e.g., less than 10% surface rusting), and location (e.g., exterior piping within battery limits) as appropriate. For each system detail surface preparation, coatings, thicknesses, application methods and other requirements. Substrates for which no coating system is given will not be recoated/repainted under the contract.

**9.3.4 Substitutions:** Specify conditions and procedures under which coatings not specified can be substituted for those specified.

**9.3.5 Color Schedule:** Provide a complete list of finish colors by item/area. Specify that the contractor should contact the owner for clarification when a finish color is not given in the color schedule. Whenever possible, finish colors should be established prior to bid as certain colors and color schemes are more expensive than others.

**9.3.6 Schedule:** The contract should identify the required contract milestone dates and usual working hours. The contract should outline under what conditions overtime will be permitted and/or required. The contract may include the contractor's proposed work schedule to meet the required contract milestone dates.

**9.3.7 Inspection and Quality Requirements:** Give the inspection criteria and quality control requirements for each coating system. Establish hold points for owner inspection.

**9.3.8 Plant Security Requirements:** The contract should outline all required procedures necessary for the contractor to comply with the owner's plant security program.

Provided by : www.spic.ir Licensee: NISOC Library

**9.3.9 Site Conditions:** The contract should identify:

a. What access is available to the work?
b. What is the condition of the area upon turnover to the contractor (i.e., Will the weeds be cut down? Will existing inventory or spare equipment be moved?)
c. Who is responsible for identifying and correcting piping, equipment, and tank leaks?
d. What requirements should be taken prior to spray painting in order to prevent overspray damage?
e. What are the requirements for site cleanup daily, weekly, and at end of job?

**9.3.10 Protection of Existing Plant and Equipment:** Identify all the steps which should be taken by the contractor and/or owner to protect the existing plant and equipment from the planned operations. Establish hold points to verify that the proper protection is in place prior to proceeding with operations.

**9.3.11 Safety Requirements:** The contractor is responsible for all safety practices required by his operations. Some of the most important include confined area procedures, clothing and personal protection equipment, storage, breathing air and respiratory requirements, grounding, ventilation, scaffolding and training. He should be familiar with "right-to-know" laws. The contractor should be advised of all hazards specific to the plant and all plant safety procedures, including work tag requirements (Note 14.3).

**9.3.12 Hazardous Waste:** The owner shall notify contractor if lead- or chromate-containing paints or other hazardous materials are to be removed. Owner shall also indicate the extent of responsibility of contractor for generating, containing, collecting samples, testing, and disposing of hazardous waste.

**9.3.13 Access for Inspection:** The contractor shall make reasonable access to the work for the owner's inspectors, including use of the contractor's scaffolding, work platforms, and safety apparatus.

**9.3.14 Owner-Furnished Items and Services:** It is often necessary and/or economically beneficial to the owner to make various items and services available to the contractor. These include: laydown/storage areas, electric power, potable water, restrooms, etc. For any utilities provided, owner should identify locations, pressures, amounts, fittings, voltages, and other pertinent operating details.

**9.3.15 Warranty/Guarantee:** The most common warranty for coating work is a one year warranty against defective materials and workmanship. Extended period performance warranties are becoming more common and when utilized should be formulated to correlate with the specific coating systems utilized.

**9.4 ESTABLISH CONTRACT FORMAT:**

**9.4.1 Fixed Lump Sum:** In this type of contract, the total amount is determined in advance, although in some cases a price escalator clause may be included for unanticipated increases in costs of labor or materials. This is the most common contract format, and is the best means to ensure competitive pricing.

**9.4.2 Cost-Reimbursable Plus Fixed Fee or Percentage:** In this type of contract, the contractor gets paid for his actual costs of labor and materials (often called "Time & Materials" contract). This type is often used when the work scope cannot be well defined (for example, when working under severe restrictions or with new equipment or materials). This format is useful for negotiated contracts or for service contracts (i.e., contract covering maintenance of a plant for a given painting season).

**9.4.3 Sole-Source Responsibility Maintenance Contracts:** In this type of contract, the contractor furnishes materials and agrees to a specified condition for a period of 10-15 years. For any degradation below that condition (e.g., 1-5% rust), contractor will repaint with no added charge. This type of service now is offered by paint manufacturers, consulting engineering firms, and painting contractors.

**9.4.4 Incentive Contracts or Clauses:** These types of contracts provide for provision of payment based on time of completion and/or cost targets. They are useful for negotiated contracts or for new methods or technology. Penalties may be assigned if contractor runs beyond scheduled completion date.

**9.5 ESTABLISH PROCEDURES FOR OWNER-CONTRACTOR RELATIONS:**

**9.5.1 Identification of Owner and Contractor Representatives:** The contractor and owner should each appoint his authorized representative to whom all required notifications are given, through whom contract changes are processed, and who is responsible for contract coordination and resolution of nonconformances and other problems.

**9.5.2 Interface with Plant Operation:** The contract should identify all plant operations and operations of other contractors which will be ongoing in the work area. The contract should outline how the coating work will interface with these operations and what precautions will be necessary. Special efforts should be made so that conflicting operations such as welding and spray painting do not occur simultaneously in the same area.

**9.5.3 Resolving Disagreements:** A procedure should be established for resolving disagreements. Most disputes

Provided by : www.spic.ir Licensee: NISOC Library

can be settled between engineer and contractor's field supervisor. In some cases additional owner or contractor officials must be consulted. Ultimately, resolution may require arbitration or litigation.

## 10. Task 6: Secure Contracts for Labor and Materials

**10.1 ROLE OF COATINGS SPECIALIST:** The actual administration of the contract (authorization of work for contract, issuance of request for quotations, review of financial or other prequalification requirements, scheduling, etc.) is often handled by a special contracts administration group. The coating or maintenance engineer, however, should be familiar with how these activities are conducted and if possible review the documents while in preparation, in particular the schedule.

**10.2 PREPARE CONTRACT AND SCHEDULE:**

**10.2.1** It is useful to prepare a list of the various activities required in securing the contracts and the time allotted for each of these. Typical elements of this schedule are as follows:

a. Prepare Contract Documents
b. Notice Inviting Proposals
c. Pre-Bid Conference
d. Pre-Bid Demonstration/Inspection
e. Proposal Due Date
f. Post-Bid Meetings and Clarifications
g. Negotiations
h. Contract Award
i. Pre-Job Conference/Demonstration
j. Contract Start Date
k. Contract Termination Date
l. Agency Acceptance Date
m. Warranty Date

**10.2.2** Specific sample clauses on these and other details required in obtaining contracts may be found in NACE Publication 6J162 (Note 14.3).

**10.3 ARRANGE AND CONDUCT PRE-BID CONFERENCE:** All prospective or qualified bidders are invited to attend a meeting with the owner's representative to review the bid package. This review would normally include an explanation of the surface cleaning and application requirements, the nature of the structure, its condition, access to the structure, special restrictions (e.g., on blast cleaning safety requirements), and answer any questions the contractor might have. Ordinarily, an actual visit to the structures or facility to be painted should be required. Many contractors are reluctant to attend pre-bid meetings because of the cost, time or simply not wanting to let his interests be known. For major and critical projects, experienced owners often make pre-bid attendance mandatory, because it eliminates problems that occur when contractors are not familiar with the structure or the terms of the specifications. Unfortunately, some public agencies have not been permitted to require contractors to attend these meetings.

**10.4 REVIEW BID AND AWARD CONTRACT:** This operation is normally strictly governed by agency legal policies and requirements. The contractor who has met the previous requirement with the lowest bid is generally awarded the contract.

**10.5 PRE-JOB CONFERENCE:** This meeting is held between the owner and the contractor hired to do the job. It is strongly advised that the owner's representatives include the coating specialist, the project engineer, and the owner's inspector. Owners may need to include representatives from their internal safety and environmental departments in these meetings. The contractor should bring the field superintendent and the company principal or his representative. The purpose of this meeting is to review in detail the specific work assignments, schedules, needs for coordination, and procedures for formal and informal communication. The conference must include a review of the work area; pointing out safety hazards, facilities and equipment which require protection or special care; and safety and emergency systems available.

**10.6 PROCURE PAINTS ACCORDING TO SPECIFICATION:** The procuring of the paints may be done by the owner or the contractor. In either case, it is necessary to verify that the paints have met the specification. The owner's inspector should ensure that the materials supplied to the jobsite are properly labeled, and that proper certifications have been obtained, and that samples are retained for testing by the owner's lab, an independent laboratory, or for future reference. Any exceptions or replacements should be noted.

## 11. Task 7: Monitor, Conduct and Inspect Repainting of Structure

**11.1 ESTABLISH RULES FOR COORDINATION:** Ensure that all personnel are familiar with responsibilities and procedures and that authorities of engineer, inspector, foreman, and paint manufacturer's representative are defined. In particular, identify the individual responsible for inspection and his affiliation (e.g., owner's representative, third party, or other). Review procedures established for handling problems (Section 9.5).

**11.2 PRELIMINARY CHECKS:** Ensure that the most recent specifications are in use for paint materials and surface preparation. Verify that structure description and description of condition contained in bid package are accu-

Provided by : www.spic.ir Licensee: NISOC Library

rate. Before initiating work, ensure that authorizing engineer, project manager, and inspector are available.

**11.3 INSPECTION BEFORE REPAIR AND SURFACE PREPARATION:** There are a number of standard inspection procedures that must be done prior to the surface preparation. Weather conditions must be suitable, the primary requirement being that surface temperatures be at least 5°F (3°C) above dewpoint. The equipment for blast cleaning should be of adequate capacity to do the job at hand. Operators should be knowledgeable in safety and operational features, including personal protective equipment. In some cases, special provisions must be taken to ensure compliance with various regulations, such as air pollution (i.e., dust containment), and proper containment and storage of abrasive waste.

**11.4 INSPECTION DURING AND AFTER PAINT APPLICATION:** Most paints have lower and upper temperature application limits and a maximum relative humidity of about 85%. For spraying, winds should be less than 10-15 mph. Assigned personnel should verify that proper materials are on hand and are mixed (including induction time if necessary) and applied properly and that equipment is in operating order. The inspector must also check the wet and dry film thicknesses, the number of coats, the film appearance, presence of pinholes and other film defects, the proper intervals between coats, and assure removal of any intercoat contamination. Other items requiring verification include protection of existing plant, equipment, and adjacent surfaces not to be coated, coordination of coating work with other ongoing activities in the work area, and proper disposal of waste material.

**11.5 FINAL INSPECTIONS:** The responsible engineer should verify that all aspects of the job have been completed before signing off. Samples of paints, thinners, and abrasives should be retained and properly labeled, the field inspection reports and any problems should be documented and signed by the required officials. Additional details on various inspection procedures are given in Chapter 6 of the SSPC Painting Manual Volume 1, "Good Painting Practice".

**11.6 ANTICIPATE THINGS THAT CAN GO WRONG:** It is useful to be prepared for factors that can delay or disrupt the progress of the job. If possible, prepare contingencies for some of the following factors:

**11.6.1 Weather Variability:** A weather factor should be included in the contract schedule; it should be made clear that no compromise will be made in weather requirements for surface preparation or application.

**11.6.2 Disagreement Over Contents or Compliance with Specifications:** The protocol for resolving such a dispute should be in writing and enforced by the project engineer, if other means are unsatisfactory.

**11.6.3 Interruptions from Outside Factors:** This can include labor dispute, delay in receipt of materials or other emergencies. It is essential to fully document all such delays and to be aware of whom to contact to resolve such problems.

**11.6.4 Equipment Malfunction:** Contractor is normally responsible for his equipment, and should be prepared to make speedy replacement of vital components.

**11.6.5 Underestimation of Materials or Surface Preparation Requirements:** Contractor is responsible to furnish all materials and services necessary to complete the project as stipulated by the contract document. If these are imprecise, contractor may elect to procure additional materials and put in a claim afterwards.

**11.6.6 Environmental, Health, and Safety Problems:** Enforcement of certain regulations is very sporadic; contractor may find it difficult to be aware of obscure regulations if not pointed out by owner. Nevertheless, contractor will be held responsible for any problems which arise unless specifically excluded or otherwise referenced. Procedures should be established in advance for dealing with new or unanticipated requirements for monitoring or containing operations.

**11.6.7 Non-uniformity in Color or Appearance:** One problem is the vagueness of specifications calling for "good workmanship." If appearance factors are important, the specification should include definitions of these appearance factors.

## 12. Task 8: Plan and Implement Follow-up Activities

**12.1 BENEFITS OF FOLLOW-UP:** An important part of a maintenance painting program is to monitor the performance of the applied coatings system, both for short-term and long-term effects. In the short term, certain inspections and follow-ups are necessary to ensure that the contractor has fulfilled the requirements of the contract. For the long term, there are certain beneficial measures that can be done to minimize the onset of corrosion and information that can be collected that will facilitate future decisions on maintaining the structure.

**12.2 ESTABLISH NEED FOR PERIODIC INSPECTION:** inspection should be made of the structure within 6 to 12 months after application. In many cases, there are surfaces such as edges or bolts which will delaminate or rust within a short period of time due to improper applications or specially severe conditions. If these are corrected

Provided by : www.spic.ir Licensee: NISOC Library

within the first year or so, the need for later maintenance may be minimized. Some agencies include a one-year touchup as part of a contractor's obligations in the contract, to cover such contingencies. Other warranted work should also be inspected prior to expiration of warranty.

**12.3 ESTABLISH SCHEDULES FOR CONDITION ASSESSMENT:** In addition to the above, a structure should be scheduled for a periodic inspection/evaluation or condition assessment. Depending on the type of structure and the environment, this first inspection would normally be conducted about five years after the original application. Specific rating sheets or parameters to be inspected should be made available to inspection personnel. The condition assessment should be similar to the one undertaken in the survey in Task 2.

**12.4 ENSURE PROPER DOCUMENTATION AND FILING OF HISTORICAL INFORMATION:** Before the job is officially signed off, it is necessary that all documentation be completed. The record of the daily inspection logs, the records of the paint procured, used, discarded or disposed of should be properly stored in the agency files. It should be verified that the retained samples of the paint are properly labeled and stored for future reference.

**12.5 INSTITUTE PREVENTATIVE MAINTENANCE MEASURES:** In some cases, regular removal of contaminants can eliminate potential problems before they become severe. Examples are chemical spills which might occur or concentrations of deicing salts. In some cases, moderate design changes can be made which will eliminate water or other chemicals collecting in crevices or other vulnerable areas.

**12.6 MAN-HOUR AND PAINT CONSUMPTION RECORDS:** Information regarding expended man-hours and paint quantities can be beneficial in preparing cost estimates for similar work. Tracking mechanisms should be defined in the contract documents. Also, owners should request copies of contractor inspection reports and daily logs for their files.

## 13. Disclaimer

**13.1** While every precaution is taken to insure that all information furnished in SSPC guides and standards is as accurate, complete, and useful as possible, SSPC cannot assume any responsibility nor incur any obligation resulting from the use of any materials or methods specified therein, or of the guides or standards themselves.

## 14. Notes

The following references may contain useful supplementary information:

**14.1** Steel Structures Painting Manual, Vol. 2: Systems & Specifications, "Selection of Painting Systems by Environmental Zone" Chapter 1. (SSPC, Pittsburgh, PA, 1982).

**14.2** Steel Structures Painting Manual, Vol. 1: Good Painting Practice, "Quality Acceptance of Paints As Received by the User," Chapter 7.2. (SSPC, Pittsburgh, PA 1982).

**14.3** NACE Publication 6J162, "Guide to Preparation of Contracts and Specifications for Application of Protective Coatings." (NACE International, Houston, TX 1962).

**14.4** PDCA Safety & Loss Control Manual. (Painting and Decorating Contractors of America, Fairfax, VA 1984).

**14.5** Journal of Protective Coatings & Linings, "Perspectives on Removal of Soluble Salts," Volume 4, No. 10, October 1987.

**14.6** Guide to Bridge Painting, FHWA TS-89-14. (Federal Highway Administration, Washington DC - 1989). Also available as SSPC Publication Number 89-04.

## APPENDIX A - DETERMINING COMPATIBILITY OF NEW PAINT OVER EXISTING PAINTS

A compatibility test is normally recommended to determine degree of surface preparation required; degree of adhesion of new paint to existing paint; and whether the new paint system will lift, deform, or adversely affect the integrity of the existing paint.

One procedure that may be used is as follows:

1. Select a minimum of three representative areas on surface to be painted. Each area should be approximately 4 to 6 square feet (0.4 to 0.6 square meters). (See Note A-1.)

2. Remove chalking, oil, and grease and visible surface contaminants, in accordance with SSPC-SP 1, Solvent Cleaning.

3. To determine if scarification of the existing paint may be required to achieve proper adhesion, scarify one-half of each test area (approximately 2 to 3 square feet [0.2 to 0.3 square meters]) after cleaning in accordance with Item 2.

4. Apply candidate coatings by proposed method of application.

5. Inspect surface after approximately 1, 3, and 7 days for signs of lifting, wrinkling, cracking or other film defects. (See Note A-2.)

6. After seven days, evaluate adhesion of new coating to existing coating in accordance with ASTM D 3359. Compare scarified area to non-scarified area. (See Note A-3.)

Provided by : www.spic.ir Licensee: NISOC Library

**NOTES:**

A-1. If a 4 square foot (0.4 square meter) area is not available, several smaller areas may be used.

A-2. Consult paint manufacturer for acceptable weather conditions for drying and curing.

A-3. Compatibility tests will determine degree of initial adhesion, but long-term performance is unpredictable.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# COMMENTARY ON QUALIFICATION PROCEDURES

## 1. History of QP Standards

This commentary is for information only and is not part of SSPC-QP 1, QP 2, QP 3, QP 4 or QP 5. SSPC currently develops six types of consensus standards, one type being the "Qualification Procedure," or QP. QPs are published procedures, developed by SSPC technical committees through a consensus process, which define a sequence of actions or functions a contracting firm or other entity must meet to establish a level of competence or qualification. This commentary will summarize the current QPs and explain how they can be used to improve the process of qualifying a contractor or other entity to perform work.

The first three qualification procedures, QP 1, QP 2, and QP 3, were developed by SSPC to form the basis of administrative certification programs designed to provide facility owners and others with a tool to use when evaluating the qualifications of contractors who apply protective coatings in the field or shop. Because of the enormous task of reviewing submittals and evaluating contractors on site and the annual volume of industrial painting projects contracted each year, SSPC established these certification programs as a service to the facility owner who otherwise would lack the staff and time to review applications and visit contractors on site to qualify them for QP 1, 2 or 3. Larger organizations who have the staff and time to evaluate contractors in house, can use QP 1, 2 or 3 as a basis to determine the primary capabilities of the contractors they hire for painting as an alternative to requiring SSPC certification.

QP 4 and QP 5 were developed by SSPC to provide facility owners with a standard to measure the qualifications of demolition and repair contractors as well as inspection agencies. SSPC has no administrative certification programs for QP 4 or QP 5.

## 2. Summary of SSPC Qualification Procedures

**2.1 SSPC-QP 1, "STANDARD PROCEDURE FOR EVALUATING PAINTING CONTRACTORS (FIELD APPLICATION TO COMPLEX INDUSTRIAL STRUCTURES)":** SSPC issued the first version of QP 1 in September, 1989 after consensus on its content was reached by the C.3.5 Technical Committee on Applicator Prequalification. QP 1 was reviewed and reissued in August, 1998.

QP 1 is essentially the basis for SSPC's Painting Contractor Certification Program (PCCP), also established in 1989. The PCCP is an administrative program set up by SSPC to independently evaluate industrial painting contractors against the requirements of QP 1 and other QPs.

The QP 1 procedure identifies four function areas of the contractor's quality system that have to be evaluated: management procedures; technical capabilities; quality control procedures; and safety and health compliance procedures. The objective of using the certification is to determine whether the painting contractor has the capability to perform surface preparation and coating application in the field (i.e. on site) on complex industrial structures such as bridges, storage tanks, power generation facilities, and industrial structures.

Once SSPC determines, through its evaluation process, that a contracting firm meets the requirements of QP 1, SSPC issues a certificate to that effect. The evaluation process consists of a review of detailed submittals and an on- site audit at both the contractor's business offices and an operating job site. Facility owners and others who hire industrial painting contractors can then use this certification as part of the prequalification process for evaluating bids or proposals from contractors.

**2.2. SSPC-QP 2, "STANDARD PROCEDURE FOR EVALUATING THE QUALIFICATIONS OF PAINTING CONTRACTORS TO REMOVE HAZARDOUS PAINT":** SSPC issued QP 2 in late 1993 as an interim standard. A final version of QP 2 was issued in August, 1995. A revised version was issued in 2000 through the Hazardous Paint Removal Qualification technical committee.

QP 2 is the basis for the QP 2 certification program, developed as a supplement to the QP 1 program in 1993 as part of PCCP's first expansion. As with QP 1, the consensus qualification procedure formed the basis of an administrative program to evaluate whether a contractor, that met the requirements of QP 1, also had the capability to effectively manage the removal of hazardous (e.g. lead based) paints from industrial structures.

QP 2 establishes several categories of qualification based on the contractor's capability to remove and contain hazardous paint debris. In addition to meeting the requirements of QP 1, five more function areas of the contractor's quality system are evaluated. They include: management of hazardous paint removal operations; technical capabilities; qualifications of competent persons; and specific safety, health and environmental compliance criteria as they relate to hazardous paint removal operations.

As with QP 1, contractors seeking QP 2 certification must provide a series of submittals to SSPC for review and acceptance and also undergo an audit at one of their active hazardous paint removel job sites. QP 2 is intended to be used side by side with QP 1 to evaluate painting contractors

Provided by : www.spic.ir Licensee: NISOC Library

who must remove hazardous paint in conjunction with surface preparation and maintenance repainting operations.

**2.3. SSPC-QP 3, "STANDARD PROCEDURE FOR EVALUATING THE QUALIFICATIONS OF SHOP PAINTING CONTRACTORS":** SSPC published QP 3 in 1995. QP 3 defines a procedure for evaluating shop painting organizations (e.g. shipyards; fabrication shops; blast and paint shops) that apply industrial protective coatings in a permanent, stationary facility or shop. The requirements for QP 3 are similar to those for QP 1 except that they are geared toward shop coating operations.

SSPC also set up an administrative program in 1996 to evaluate shops against the requirements of QP 3. Facility owners and others who contract for shop painting services use this program to evaluate the capabilities of the paint shop. QP 3 establishes several qualification categories based on the degree to which the shop can isolate coating operations from outdoor weather conditions.

SSPC revised its QP 3 procedure and administrative certification program in 1999 to coordinate its program with that of the American Institute of Steel Construction (AISC) which certifies structural steel fabrication shops that apply protective coatings in the shop after fabrication. The AISC Sophisticated Paint Endorsement (SPE) program is recognized by SSPC as an equivalent to SSPC's QP 3 program, with the exception of safety, health, and environmental compliance. AISC does not address the latter in its SPE certfication program.

**2.4 SSPC-QP 4, "STANDARD PROCEDURE FOR EVALUATING THE QUALIFICATIONS OF CONTRACTORS DISTURBING HAZARDOUS PAINT DURING DEMOLITION AND REPAIR WORK":** SSPC-QP 4, developed by the SSPC 5.3 Technical Committee on Removal of Hazardous Coatings, was issued by SSPC in 1997. It is similar to QP 1, QP 2 and QP 3 in that it establishes a consensus procedure to evaluate the capability of a general contractor to invoke appropriate worker and environmental protection programs while disturbing hazardous (e.g. lead based) paint incidental to demolition or repair work.

QP 4 is intended to evaluate contractors who are not painting contractors but who disturb hazardous paint in conjunction with non-painting work such as bridge demolition or structural repair. A painting contractor certified to QP 2 also meets the requirements of QP 4 and thus is also capable of performing such demolition and repair work.

QP 4 differs from QP 1, 2 and 3 in one important aspect: SSPC does not offer an administrative certification program to evaluate general contractors against the requirements of QP 4. This is primarily because SSPC does not normally provide services to repair and structural demolition contractors who tend to belong to other trade or professional associations that represent their interests.

The impetus for QP 4 came from bridge maintenance authorities who asked SSPC to develop a procedure for such work which they could then invoke in their contracts for repair and demolition work. This would ensure that the repair contractor was capable of implementing the same worker and environmental protection programs on site as the painting contractors are required to do under QP 2.

**2.5 SSPC-QP 5, "STANDARD PROCEDURE FOR EVALUATING THE QUALIFICATIONS OF COATING AND LINING INSPECTION AGENCIES":** SSPC-QP 5, developed by the SSPC C.6 Group Committee on Education and Certification, was isued by SSPC in 1999. It differs from the QP standards mentioned above in that it establishes a procedure to evaluate companies that provide coating inspection services rather than contracting firms performing construction work.

SSPC does not currently offer an administrative certification program to QP 5, but is studying the feasibility of doing so in 2001. QP 5 provides facility owners, when issuing requests for proposals (RFPs) for inspection services, with a standardized criteria for evaluating and qualifying inspection firms. Facility owners can use QP 5 by requiring firms submitting proposals for coating inspection work to submit evidence that they meet the requirements of SSPC-QP 5 as part of the owner's evaluation process prior to selecting an inspection firm.

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC: The Society for Protective Coatings
# QUALIFICATION PROCEDURE NO. 1
## Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)

## 1. Scope

**1.1** This procedure describes a method for evaluating the qualifications of industrial field painting contractors and defines a minimum standard for qualification.

**1.2** The objective of this procedure is to determine if a painting contractor has the personnel, organization, qualifications, procedures, knowledge, and capability to perform surface preparation and coating application of the required quality under the conditions and restrictions specified by the owner for complex structures.

**1.3** The procedure encompasses the field application of coatings in the industrial market. Specialty applications, such as lining materials, bituminous products, galvanizing, etc., are not covered by the requirements of this standard procedure.

**1.4** The procedure does not include surface preparation and coating application conducted exclusively at the contractor's facility (i.e., shop painting). Shop painting is covered by the latest revision of SSPC-QP 3, "Standard Procedure for Evaluating the Qualifications of Shop Painting Contractors." Also see Section 6.1 of this standard procedure.

## 2. Description

**2.1 DEFINITIONS:**

**Contractor:** An individual or firm whose primary business is providing surface preparation and coating application services in the industrial, marine, and heavy commercial markets.

**Auditor:** 1) The person or persons performing audits on behalf of the auditing agency or qualifying agency. 2) The body possessing the necessary technical competence to review contractor submittals, conduct on-site audits of applicants, and report results to the qualifying agency in compliance with the requirements of this procedure and the written requirements of the formal audit program.

**Qualifying Agency:** The body responsible for development, maintenance, sponsorship and operation of a program to ensure uniform compliance with the provisions of this standard procedure.

**Complex Structure:** Complex structures are those constructed of steel or concrete, such as metal producing and rolling mills, bridges, and processing facilities, including chemical and petrochemical processing plants, pulp and paper mills, power plants and substations, and food and beverage plants and terminals.

**Qualification:** The procedure by which written assurance is given that an applicant conforms to the prescribed set of conditions or requirements of this standard procedure.

**Procedure:** The sequence of steps taken to carry out a particular course of action.

**2.2 TYPES OF STRUCTURES:** Complex structures encompass a wide range of structural types and configurations. Although the required evaluation functions are similar for all complex structures, the specific skills (e.g., rigging or pollution controls) may be quite different for painting a bridge and painting a process facility.

This procedure does not in any way differentiate between contractors engaged in work in different industries and on different structures. Owners may wish to select contractors with the specific skills and experience required for the particular job at hand. Some industrial subcategories with which specific skills may be associated are listed below:

- Marine/splash zone: These include structures proximate to and remote from both coastal and inland shorelines
  - Proximate includes waterfront structures, locks, dams, ship hulls, bulkheads, piers, etc.
  - Remote includes offshore platforms and structures, etc.
- Bridges and towers.
- Metal and manufacturing facilities.
- Chemical and processing facilities: These include chemical and petrochemical plants, pulp and paper mills, food and beverage plants, and water and waste facilities.
- Power generation facilities and distribution structures.

**2.3 FUNCTIONS TO BE EVALUATED:** The procedure identifies four functional areas to be evaluated: Management Procedures, Technical Capabilities, Quality Control, and Safety and Health. General requirements for each of these function areas are presented in Section 3.

Provided by : www.spic.ir Licensee: NISOC Library

**2.4 EVALUATION PLANNING:** The qualifying agency must develop criteria and/or rating plans to evaluate each contractor against this standard. The qualifying agency shall also determine which of the specific, critical items within the four function areas are to be evaluated for subsequent follow-up or evaluations, ensuring the items evaluated are the same for all contractors. The sequence of steps for conducting an evaluation within a certification program is outlined in Section 4. The evaluation, in each instance, will be performed by the auditor.

## 3. General Qualification Requirements

**3.1 MANAGEMENT PROCEDURES:** The applicant must demonstrate adequate procedures for disseminating company policy and for personnel, administrative and financial management as follows:

**3.1.1 Contractor Policy:** The contractor shall have:

a. Written policies on quality, safety, and health.
b. Written procedures for disseminating company policies within the organization. The contractor shall demonstrate that procedures are followed.

**3.1.2 Organization and Personnel:** The contractor shall have:

a. Organizational chart showing division of responsibility within the contractor's company.
b. List of names, titles, duties, and job descriptions for key personnel (management, technical, quality control, safety). The job description shall state the experience, licenses, certifications and training and refresher courses required for each position.

**3.1.3 Administrative and Management Procedures:** The contractor shall provide:

a. A brief, written description of the contractor's method of financial record keeping.
b. Procedures used for contract estimating and scheduling, and for cost accounting.
c. Procedures used to review specifications and other bid documentation.
d. Formal procedures for learning about and meeting current federal, state and local environmental, health, and safety regulations.

**3.2 TECHNICAL CAPABILITIES:** The contractor must employ qualified personnel; have adequate technical resources; have suitable job conversion procedures; and have appropriate equipment, facilities, and experience. The contractor shall provide the following:

**3.2.1 Personnel Qualifications:**

a. Records of training that is available to and utilized by qualified workers, including training required to meet regulatory requirements.
b. A method for monitoring proficiency of workers performing surface preparation and coating application and relevant documentation.
c. Qualified site personnel, including surface preparation and coating application personnel.

**3.2.2 Technical Resources:**

a. A list of technical societies, trade bodies, or other industry groups (universities, major manufacturers, consultants) with which the contractor is associated. Current membership certificates or correspondence shall be maintained to verify the association.
b. Verification that the company maintains a library of current technical standards appropriate for types of work performed.

**3.2.3 Procedures:** Formal procedures which are used to convert job specifications into field work orders, job plans, etc., including procedures for:

a. Logging receipt of specifications and revisions and recording who gets copies, as well as removing obsolete or superseded documents from the workplace.
b. Documenting communication which notes exceptions to specifications or other clarifications.
c. Communicating specification requirements to site based personnel.
d. Quality assurance programs (where used). Work procedures should specifically define quality assurance methods and criteria.
e. Safety and health compliance program.

**3.2.4 Equipment, Facilities, and Experience:**

a. List types of materials that have been applied within the previous 18 months.
b. Listing of current (site based) jobs and jobs recently completed on complex structures within the previous 18 months which support the contractor's suitability for certification. The list should include the following:
   - Client name, address, and principal contact
   - Description of the work performed
   - Materials applied
   - Equipment used
   - Types and number of personnel employed
   - Any special requirements or provisions (e.g., safety or environmental)

c. List of contractor-owned or leased equipment utilized.
d. Formal description of maintenance and repair procedures utilized for equipment, including repair logs.

**3.3. QUALITY CONTROL:** The contractor must demonstrate that it uses qualified personnel and proper inspec-

Provided by : www.spic.ir Licensee: NISOC Library

tion and recording procedures for job quality control.

**3.3.1 Personnel Qualifications:** Documentation that personnel performing quality control related functions are qualified, including records of training and experience of qualified supervisor and inspectors, and a description of qualification requirements for inspectors as well as a detailed job description.

**3.3.2 Inspection Procedures and Recording Systems:** The contractor must demonstrate the following:

a. Records of standards and specifications for coating inspection work are available and utilized.
b. An implemented system for maintaining and filing inspection reports is in place.
c. Inspection equipment and calibration standards and procedures are available and properly utilized by on-site Q.C. personnel.
d. Procedures to stop non-conforming work are utilized by on-site Q.C. personnel.
e. Procedures for verifying proper coating application are available and utilized by on-site personnel.
f. Procedures to ensure that each major operation (e.g., surface preparation, primer, intermediate and topcoat application) is inspected are available to on-site personnel and utilized.

**3.4 SAFETY AND HEALTH:** The contractor must operate a proper and compliant safety and health program, maintain safety records and provide access to safety resource material as follows:

**3.4.1 Safety Procedures and Record-Keeping Systems:**

a. Document all safety education meetings and related activities.
b. Hold and document pre-job safety meetings.
c. Report accidents in accordance with regulations.
d. Operate a formal procedure for determining the proficiency of the safety and loss control program.
e. Provide formal safety procedures and training for operating specialized equipment.
f. Provide adequate personal protective equipment and operate a formal system to check the effectiveness and maintenance of the equipment.
g. Make available employees trained in first aid on all sites where work is performed on complex structures.
h. Enforce all safety rules.
i. Keep records of non-compliance with federal, state, and local regulations, and document that corrective actions are taken to avoid repeat violations.

**3.4.2 Resource Materials:**

a. Maintain a list of available safety resource materials.
b. Operate a formal procedure for acquiring safety information and materials.
c. Operate a formal procedure to ensure that safety information and materials referenced in submittals are available to on-site personnel.

## 4. Evaluation Sequence

**4.1 SUBMITTAL OF WRITTEN APPLICATION PACKAGE:** The initial step is to request an application form and instructions. The request, along with an application fee (when applicable), must be submitted to the qualifying agency.

The application process involves gathering required information about the contractor as described in the application form. This information and documentation will be submitted to the qualifying agency at the same time as the formal application for qualification.

**4.2 REVIEW OF APPLICATION PACKAGE:** The contractor's application package is reviewed by the qualifying agency using guidelines for evaluation which have been established by that agency. The evaluation items are based on Section 3 of this document.

**4.3 ON-SITE AUDIT OF CONTRACTOR:** Subject to satisfactory evaluation of the application package referred to in 4.2 and on a date mutually agreed upon by the contractor and the qualifying agency, an auditor representing the qualifying agency will visit the contractor's premises and complex structure job site to investigate and rate the following areas directly and indirectly affecting quality of work provided: Management Procedures, Technical Capabilities, Quality Control and Safety and Health. The auditor will perform the following:

- Confirm data submitted with the application for qualification.
- Conduct interviews with key supervisory personnel and some subordinate employees.
- Observe and rate the organization and operation, including management procedures, technical capabilities, quality control, and safety and health.
- Examine and rate equipment and facilities.

The on-site audit will usually require from one to three days to complete.

**4.4 EXIT INTERVIEW:** Following the site audit, and before the auditor leaves the site, an exit interview will be held. At the exit interview, the auditor will review observations and the evaluation with the contractor, including discussions of deficiencies and omissions, if any. A written schedule of deficiencies and omissions will be provided to the site supervisor, who will be asked to confirm receipt of the schedule. Every attempt is to be made by the auditor during the exit interview to explain why deficiencies were

Provided by : www.spic.ir Licensee: NISOC Library

cited.

**4.5 EVALUATION OF APPLICATION AND DETERMINATION OF STATUS:** At the conclusion of the evaluation process, the auditor will make recommendations to the qualifying agency, which will make the final decision regarding applicant status.

**4.5.1 Qualification:** The auditor has determined that the contractor has met or exceeded the requirements of Section 3 above. The qualifying agency will make final determination of the contractor's qualification status based on the recommendation of the auditor and disciplinary or other evaluation criteria defined in the application materials. Upon acceptance of this recommendation, the qualifying agency will issue a certificate identifying the contractor by name and by location of the contractor's home office. Subsequent annual reconfirmation is subject to the qualifying agency's requirements.

**4.5.2 Withhold Qualification:** The auditor has determined that the contractor has not met the requirements of Section 3 above. Following any discussion necessary between the auditor and the qualifying agency, qualification may be withheld. If qualification is withheld, the qualifying agency shall submit to the contractor an itemization of deficiencies that resulted in the decision to withhold qualification. The contractor will be allowed 90 days after notification to submit corrective actions, and request an on-site re-audit.

**4.6 METHOD OF APPEAL:** If a contractor disputes the qualifying agency's decision, the contractor may appeal, utilizing the following steps of recourse:

- Notifying the qualifying agency within 10 working days after notification of audit results, specifically identifying reasons for the appeal.
- The contractor may arrange with the qualifying agency to have a second independent auditor acceptable to both parties brought in at the contractor's expense to inspect and re-evaluate the contractor for compliance with this standard's requirements.
- In the event the foregoing step fails to resolve the dispute, a mutually agreed upon arbitration panel, consisting of three persons familiar with contracting operations in the protective coatings industry, will hear evidence and make a final decision. If the arbitration panel finds for the contractor, the cost of all fees and expenses of the arbitration panel, the representative of the evaluation team, and the qualifying agency will be shared by the contractor and the qualifying agency. If the arbitration panel does not find for the contractor, the contractor will be responsible for payment of all fees and expenses. Any other costs incurred by any party to the dispute will be borne by that party.

**4.7 RECONFIRMATION OF QUALIFICATION:**

**4.7.1 Self-Audit:** The contractor shall at his own expense perform an annual self-audit, based on the requirements of Section 3 above, following initial qualification. The results of this self-audit will be forwarded to the qualifying agency, with a copy retained on file by the contractor, and will be made available to the auditor during any announced or unannounced audits.

**4.7.2 Reconfirmation of Qualification - Owner Comments:** Owners for whom the contractor performs work will have an opportunity to comment on the qualified contractor's performance by completing an owner comment form available from the qualifying agency. Comments will be in the form of replies to questions asked of owners regarding performance on specific jobs.

**4.8 REVOCATION:** Failure to satisfactorily complete the annual self-audit or pass announced or unannounced audit(s) or failure to meet disciplinary or other evaluation criteria established by the qualifying agency will be cause for suspension or revocation of certification.

**4.9. QUALIFICATION PERIOD:** The qualifying agency shall determine the time period for which qualification shall be valid, and the requalification schedule during the qualification period.

**4.10 QUALIFYING AGENCY FILES:** The qualifying agency will maintain a list of certified contractors, as well as pertinent information submitted by owners and users who have utilized the contractor's services. This information will assist in the validation process during the certification term.

All information gathered will be used only for purposes intended. Information determined to be proprietary in nature will be treated as confidential.

## 5. Disclaimer

While every precaution is taken to ensure that all information furnished in SSPC guides and standards is as accurate, complete, and useful as possible, SSPC cannot assume any responsibility, nor incur any obligation, resulting from the use of any materials or methods specified therein, or of the procedure itself.

## 6. Note

SSPC has developed a "Standard Procedure for Evaluating the Qualifications of Painting Contractors to Remove Hazardous Paint" (SSPC-QP 2) and a "Standard Procedure for Evaluating Qualifications of Shop Painting Contractors" (SSPC-QP 3). In the future, additional qualification procedures may be established for linings and critical underwater service, and other specialized structures or industries.

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC: The Society for Protective Coatings

# QUALIFICATION PROCEDURE NO. 2

## Standard Procedure for the Qualification of Painting Contractors

### (Field Removal of Hazardous Coatings from Complex Structures)

## 1. Scope

**1.1** This standard procedure describes a method for evaluating the qualifications of industrial field painting contractors to remove hazardous coatings (e.g., coatings containing lead or other hazardous metals) from industrial structures. The requirements of this procedure are intended to supplement the general requirements of SSPC-QP 1, "Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)."

This procedure establishes two qualification categories for contractors removing and containing hazardous coatings. The specifier shall designate the required category for the contractor based on the type and level of containment and ventilation required (negative air pressure inside containment).

**1.2** This procedure also establishes minimum requirements for worker health and safety programs and environmental protection programs utilized by the contractor during hazardous coating removal operations.

## 2. Description

**2.1 DEFINITIONS**

**Auditor**: 1) The person or persons who perform audits on behalf of the auditing agency or qualifying agency. 2) The body possessing the necessary technical competence to review contractor submittals, conduct on-site audits of applicants, and report results to the qualifying agency in compliance with the requirements of this procedure and the written requirements of the formal audit program.

**Competent Person:** One who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, the public, and the environment, and who has authorization to take prompt corrective measures to eliminate them. OSHA requires a competent person on-site during exposure-producing operations.

**Complex Industrial Structure:** Complex structures are those constructed of steel or concrete. Examples include: metal producing and rolling mills; bridges; processing facilities, including chemical and petrochemical processing plants; pulp and paper mills; power generation plants and substations; food and beverage plants and terminals; water, wastewater, chemical, and fuel storage tanks; and transmission towers.

**Hazardous Coatings:** Coating systems that contain substances (e.g., lead or other hazardous metals) in sufficient concentrations to create an occupational hazard for the worker exposed to or handling the coating waste, or an environmental hazard in the locale where disturbance of the coating is taking place.

**Owner:** The person, company or organization who owns or operates the complex industrial structure upon which work is to be performed.

**Painting Contractor:** An individual or firm who provides surface preparation and coating application services (in the field) in the industrial, marine, and heavy commercial markets.

**Procedure:** The sequence of steps taken to carry out a particular course of action.

**Qualification:** The procedure by which written assurance is given that a contractor conforms to the prescribed set of conditions or requirements of this standard procedure at the time of the on-site evaluation.

**Qualifying Agency:** The body responsible for development, maintenance, sponsorship and operation of a program to ensure uniform compliance with the provisions of this standard procedure.

**2.2 FUNCTIONS TO BE EVALUATED:** The qualification process rates four areas: 1) Management of Hazardous Coating Removal; 2) Technical Capabilities; 3) Qualification of Personnel; and 4) Safety and Health and Environmental Compliance. Specific requirements (evaluation items) for each of these areas are presented in Section 4.

The qualifying agency shall develop specific criteria, scoring and evaluation schemes for determining the qualifications of all contractors based on the evaluation items in Section 4. For special requirements, additional evaluation items may be included.

Provided by : www.spic.ir Licensee: NISOC Library

The evaluation items, criteria, and evaluation scheme constitute the evaluation guidelines used to determine a contractor's qualifications, based on the sequence of procedures in Section 5.

**2.3 QUALIFICATION CATEGORIES**

**2.3.1** This standard establishes two qualification categories for removing and containing hazardous coatings. These categories differ in the extent of containment and ventilation required, based on whether negative air pressure and air movement are required.

Note: This standard is primarily geared toward the removal of coatings containing lead. However, if other hazardous materials are in the abrasives or previously applied coating system, the contractor is expected to be familiar with OSHA and EPA requirements for handling these materials.

**2.3.2 Category A:** This category consists primarily of dry abrasive blast cleaning, power tool cleaning, wet abrasive blast cleaning (WAB), and water jetting, within containment. It entails the use of an engineered ventilation system with negative pressure in accordance with Class 1A or 2A or 1P or 1W of SSPC Guide 6. (See Appendix A.)

**2.3.3 Category B:** This category consists primarily of abrasive blast cleaning, chemical stripping, power tool cleaning, wet abrasive blast cleaning, water cleaning or water jetting within containment in accordance with Class 3A or 4A or 1C or 2C or 3C, or 2P or 3P or 2W or 3W of SSPC-Guide 6.

## 3. References

**3.1** The standards and references listed in Sections 3.3 through 3.5 form a part of this standard.

**3.2** The latest issue, revision, or amendment of the standards and other references shall govern unless otherwise noted.

**3.3 SSPC: THE SOCIETY FOR PROTECTIVE COATINGS STANDARDS:**

| | |
|---|---|
| **QP 1** | Standard Procedure for Evaluating Painting Contractors |
| **Guide 6** | Guide for Containing Debris Generated During Paint Removal Operation |
| **Guide 7** | Guide for the Disposal of Lead-Contaminated Surface Preparation Debris |

**3.4 U.S. GOVERNMENT CODE OF FEDERAL REGULATIONS:**

29 CFR, Part 1926 Safety and Health Regulations for Construction 40 CFR, Part 50, Appendices B and G, "National Ambient Air Quality Standard for Lead"
40 CFR, Part 58, Appendices C and E, "Siting Ambient Air Monitors"
40 CFR, Part 60, Appendix A, "Standards of Performance for New Stationary Sources"
40 CFR, Subchapter D, "Clean Water Act"
40 CFR Part 122, National Pollution Discharge Elimination System (NPDES)
40 CFR 745 - Worker Training & Certification Rule

**3.5 U.S. DEPARTMENT OF LABOR, OCCUPATIONAL HEALTH & SAFETY ADMINISTRATION:**

Occupational Safety and Health Administration Guidelines on Workplace Safety and Health Program Management (Issued as 54 FR 3904, January 26, 1989)
OSHA Instruction CPL 2-2.58, Inspection and Compliance Procedures for 29 CFR 1926.62, Lead Exposure in Construction, Interim Final Rule

## 4. Qualification Requirements

The contractor shall meet the requirements of 4.1 through 4.5 belong.

**4.1** The contractor shall meet the requirements of SSPC-QP 1.

**4.2 MANAGEMENT OF HAZARDOUS COATING REMOVAL**

**4.2.1 Contractor's Company Policy:** The company mission or policy statement signed by the CEO or COO shall state in writing that the contractor is committed to the protection of workers and the public from occupational and environmental hazards associated with lead and other hazardous coating removal operations. The contractor must also present the policy verbally to those workers who may not understand the written document.

**4.2.2 Authority and Responsibility of Competent Persons**

**4.2.2.1 Authority:** The "competent person(s)," as defined in Sections 2.1 and 4.4.1, shall have the complete support of all levels of management and written authority (including stop work authority) to ensure operations are carried out in accordance with compliance plans and governmental regulations, irrespective of production pressures. To ensure sufficient authority, competent persons shall report directly to the corporate safety, engineering, quality assurance, or quality control manager, project supervisor, project manager, superintendent, CEO, or other cognizant member of management. The competent person(s) may have additional responsibilities and carry out other work assignments, but shall not routinely be a member of the work crew. A back-up "competent person" must be designated in the event the competent person is absent from the job site during exposure-producing operations.

**4.2.2.2 Responsibility:** The competent person(s) shall be responsible for overseeing hazardous coating removal operations. Responsibilities shall include:

1. Monitoring effectiveness and ensuring the contin-

Provided by : www.spic.ir Licensee: NISOC Library

ued integrity of environmental controls.

2, Supervising worker exposure monitoring or overseeing monitoring activities performed by others.

3. Ensuring that a hazard communication program and other applicable training has been conducted for the contractor's personnel on site.

4. Ensuring that employees working in the exposure area are wearing required personal protective equipment and are trained in the use and maintenance of such equipment and in the use of exposure control methods, personal hygiene facilities, respiratory protection, and decontamination practices.

5. Ensuring that any required containment or engineering controls are in operating condition and functioning properly.

6. Ensuring that fugitive emissions to air, water, or soil are minimized and that handling of all waste streams is in compliance with applicable regulations and contract specifications.

7. Controlling access to the work site and ensuring that contamination control boundaries are marked off.

8. Maintaining project documentation, such as exposure assessment results, ventilation performance checks, respirator fit tests, personal monitoring results, results of site safety inspections, medical surveillance results, etc., in accordance with the programs required in Section 4.5.

**4.2.3 Information Resources:** The contractor shall identify a source for obtaining information on relevant regulations pertaining to hazardous coating removal and industrial hygiene procedures. A reference file of information shall be maintained at the job site or be readily accessible. (See Section 4.3.4.3 for types of references.)

**4.3 TECHNICAL CAPABILITIES**

**4.3.1 Qualification Categories:** The contractor shall meet the requirements for the qualification category specified (see Section 2.3). The requirements for qualification categories A and B are given in Sections 4.3.2 and 4.3.3 below. Note: In addition to the requirements given in 4.3.2 and 4.3.3, the contractor must also meet all the other requirements of this standard.

**4.3.2 Requirements for Category A:** The contractor shall demonstrate competence in the following:

- Protecting, storing, and labeling hazardous materials and waste (see Section 4.6.1).
- Operation, maintenance, and safety when using water jetting, wet abrasive blast, dry abrasive blast, power tool cleaning or other coating removal equipment.
- Coating removal using containment and ventilation that meets the requirements of Class 1A or 2A, or 1W or 1P of SSPC-Guide 6.
- Operation, maintenance, and safety when using abrasive or water recovery equipment.
- Assessing quantity of emissions and worker exposure.
- Maintaining employee exposures below the appropriate OSHA Permissible Exposure Limit (PEL) first through use of engineering and work practice controls to the extent that such controls are feasible and secondarily through use of respiratory protection that complies with current OSHA regulations.

**4.3.3 Requirements for Category B:** The contractor shall demonstrate competence in the following:

- Protecting, storing, and labeling hazardous materials and waste (see Section 4.6.1).
- Operation, maintenance, and safety when using water jetting, wet abrasive blast, dry abrasive blast, power tool cleaning, chemical stripping, water cleaning or other coating removal equipment.
- Coating removal using containment and ventilation that meets the requirements of Class 3A, or 4A, or 2W or 3W, 1C, or 2C or 3C, or 2P or 3P of SSPC-Guide 6.
- Operation, maintenance, and safety when using abrasive or water recovery equipment.
- Assessing quantity of emissions and worker exposure.
- Maintaining employee exposures below the appropriate OSHA Permissible Exposure Limit (PEL) first through use of engineering and work practice controls to the extent that such controls are feasible and secondarily through use of respiratory protection that complies with current OSHA regulations.

**4.3.4 Verifying Qualification Categories:** The contractor shall submit evidence of successfully meeting the specification requirements of hazardous coating removal projects performed, using environmental controls in accordance with the owner's specifications.

Evidence shall entail documentation of hazardous coating removal projects in which the contractor is involved at the time of the on-site evaluation and has completed in the previous 24 months.

For an initial applicant to qualify for a specific qualification category, the auditor must observe the contractor performing work which meets the requirements of the qualification category sought. A contractor who initially qualifies for a lower category cannot move to a higher category without an auditor observing the contractor performing work which meets the requirements of the higher category. Qualification status of contractors who do not have any hazardous coating removal projects in progress at the time of annual requalification would be handled as follows. To remain qualified for a specific qualification category, the auditor must observe the contractor performing work which meets the requirements of that category at least once in the 48 months following initial qualification, provided the contractor complies with all other requirements of this standard procedure.

Provided by : www.spic.ir Licensee: NISOC Library

During the 48 months after initial qualification, the contractor shall give the qualifying agency 60 days notice of all hazardous coating removal projects prior to starting work. In addition, the contractor is subject to scheduled or unannounced follow-up audits at the discretion of the qualifying agency. A contractor who fails to report a higher category job at the time of the audit will revert to the certification category that is observed by the auditor and reviewed by the qualifying agency. If the qualifying agency fails to visit the project after being given sufficient notice, the contractor shall be considered to fulfill the audit requirements for the selected category, provided the written and photographic documentation reviewed by the auditor confirms conformance with the requirements of the qualification category held and of this procedure.

Documentation of work experience shall include the following.

**4.3.4.1** Description of the work, including:

- Facility name, address, and principal contact.
- Brief description of structure and work performed, including dates on site.
- Coating removal method used, and type of hazardous metal in coating.
- Environmental controls used.
- Types of containment and ventilation used, if applicable.
- Portion of project specification dealing with safety, health, and environmental control.
- Name of competent person(s) on site.

**4.3.4.2** Verification of successful completion of the jobs described including compliance with applicable federal, state, and local regulations enforceable during the project.

**4.3.4.3 Technical Library:** The contractor shall have or demonstrate accessibility to an up-to-date library of industrial and governmental resources on subjects related to hazardous coating removal, including:

a. Relevant federal, state, provincial, and local occupational safety and health standards, regulations, compliance directives, and guidelines.

b. Ventilation standards and procedures, if applicable.

c. Relevant federal, state, provincial, and local environmental regulations on solid and hazardous waste and on air, water, and soil quality.

d. Containment guidelines and technical data sheets (e.g., equipment operating manuals).

e. Blast cleaning and other coating removal methods (e.g., water jetting, vacuum shrouded power tool or chemical stripping).

f. Waste collection, handling, and disposal guidelines.

g. Industrial hygiene and safety practices.

### 4.4 PERSONNEL QUALIFICATIONS AND TRAINING

**4.4.1. Competent Person Training and Experience:** Evidence or documentation shall be furnished that the competent person shall have successfully completed at least 32 contact hours of training, and shall have the experience described below in Section 4.4.1.2. Unless otherwise mandated by applicable federal standards, the training program must be approved by at least one of the states maintaining a training program accreditation system applicable to the industrial coating industry. (Competent persons who have successfully completed 24 hours of equivalent training prior to the effective date of this version of QP 2 will be accepted.)

**4.4.1.1** Competent person training shall include 32 hours covering the following topics:

1. Relevant hazardous and solid waste handling procedures.

2. Relevant portions of the following regulations and standards: 1) National Ambient Air Quality Standards (NAAQS); 2) OSHA Construction Industry Standards; 3) EPA solid and hazardous waste regulations; 4) EPA site clean-up and spill response regulations; and 5) relevant state and local regulations.

3. Different removal methods, classes of containment, and environmental controls consistent with the qualification categories specified in Section 4.3.

4. All aspects of training specified in Section 4.4.2.

5. Relevant safety practices outlined in Section 4.5.

6. Annual refresher training, at a minimum of eight hours per year.

**4.4.1.2** Competent person experience shall include:

1. Minimum of two years industrial painting field experience.

2. Experience in relevant safety practices.

3. Experience in hazardous waste handling procedures relative to projects described in Section 4.3.4.

4. Experience in environmental monitoring relative to projects described in Section 4.3.4.1.

**4.4.2 Production and Support Worker Training:** Evidence or documentation shall be furnished that production and support personnel (those involved in hazardous coating removal operations or related work) shall have had at least eight hours of training annually. Note: Proposed EPA regulations may require more than eight hours of training in the future. As a minimum, the training program shall include the following:

a. Contents of 29 CFR 1926.21, 29 CFR 1926.59, 29 CFR 1926.62 and any EPA regulations in effect to comply with Title X - Lead Based Paint Reduction Act of 1992.

b. Awareness of the types of operations with lead or other hazardous metals that could result in exposure that exceeds the action levels. If no action level exists, use half of the Permissible Exposure Limit (PEL) or Threshold Limit Value (TLV) as the threshold.

c. Procedures for handling hazardous waste.

d. Proper operation and maintenance of environmental control systems (e.g., dust collectors, recycling units,

Provided by : www.spic.ir Licensee: NISOC Library

containment structures) as well as coating removal tools and equipment.

e. Contents of the contractor's general and site specific written compliance plans, as required in Section 4.5.

**4.5 REQUIRED SAFETY COMPLIANCE PROGRAMS**

**4.5.1 Safety Procedures and Record Keeping Systems:** The contractor shall have on site a written worker protection plan based on the applicable requirements of 29 CFR 1926.62 and OSHA and NIOSH Lead in Construction guidelines and compliance directives. This program shall include, at a minimum:

a. Defined responsibilities for a safety coordinator, who shall have a minimum of 40 hours of training in industrial hygiene and safety. This person may be on the contractor's staff, or the contractor may utilize the services of an industrial hygiene or safety professional with knowledge of hazardous coating removal operations. Since the competent person is required to be on site to implement all compliance activities, it is not necessary for the safety coordinator to be on site at all times. However, the safety coordinator should be available for consultation as needed.

b. Evidence that the written worker protection plan has been reviewed and formally approved by an industrial hygiene or safety professional and signed by company management.

c. Provisions for exposure monitoring.

d. Details of a compliance plan, including provisions for:

1. Protective clothing
   - working clothes provided by employer
   - laundry provided by employer
   - work clothes changed prior to leaving the work site
2. Housekeeping
   - delineation of clean and contaminated areas
   - delineation and usage of equipment storage areas
   - periodic dust and waste clean up
3. Hygiene
   - hand washing facilities
   - showers with separate clean and contaminated areas for clothing storage and changing
   - separate worker break and eating areas
4. Medical surveillance
   - pre- and post-job blood testing and physical
   - periodic blood testing
   - medical removal protection in accordance with OSHA
5. Training
   - use of equipment
   - use and maintenance of respirators
   - safety, such as the use of scaffolding, eye and ear protection, and signs and other issues characteristic of specific job requirements
6. Record keeping
   - OSHA 200 log
   - medical surveillance
   - exposure monitoring
   - training

e. Respiratory protection and medical surveillance program.

f. Employee site-specific training.

**4.6 REQUIRED ENVIRONMENTAL COMPLIANCE PROGRAMS**

**4.6.1 Environmental Compliance Plan:** The contractor shall have a written plan to protect the environment from hazardous coating debris located at the job site. This plan shall include, at a minimum:

a. An environmental protection plan detailing how the contractor controls discharges to air, soil, and water.

b. A hazardous waste materials management and disposal plan. (See SSPC-Guide 7 and 40 CFR, Subchapter 1, "Solid Wastes," Parts 260-263 and 268.)

**4.6.2 Monitoring Plan:** The contractor shall have a written procedure specifying monitoring criteria and a resulting action plan for the competent person. The plan shall require the competent person to be on site at all times (unless otherwise authorized) during exposure-producing operations. Instructions shall require this person, without regard for production pressures, to stop non-conforming operations (work that deviates from the safety, health and environmental compliance programs). This procedure shall also provide for a qualified back-up person in the event the competent person is absent from the job site during exposure-producing operations.

**4.6.3 Enforcement:** The contractor shall document that procedures and policies are in effect to ensure that the contractor's worker safety, health, and environmental compliance plans are enforced.

## 5. Evaluation Sequence

**5.1 SUBMITTAL OF WRITTEN APPLICATION PACKAGE:** The initial step is to request an application form and instructions. The request, along with an application fee (when applicable) must be submitted to the qualifying agency.

The application process involves gathering required information about the contractor as described in the application form. This information and documentation will be submitted to the qualifying agency at the same time as the formal application for qualification.

**5.2 REVIEW OF APPLICATION PACKAGE:** The contractor's application package is reviewed by the qualifying agency using guidelines for evaluation which have been established by that agency. The evaluation items are based on Section 4 above.

**5.3 ON-SITE AUDIT OF CONTRACTOR:** Subject to satisfactory evaluation of the application package referred to in 5.1 and on a date mutually agreed upon by the contractor and the qualifying agency, an auditor represent-

Provided by : www.spic.ir Licensee: NISOC Library

ing the auditing agency will visit the contractor's premises and complex structure job site to investigate and rate the following areas directly and indirectly affecting quality of work provided: MANAGEMENT OF HAZARDOUS COATING REMOVAL, TECHNICAL CAPABILITIES, QUALIFICATIONS OF PERSONNEL and SAFETY, HEALTH, AND ENVIRONMENTAL COMPLIANCE. The auditor will perform the following:

- Confirm data submitted with the application for qualification.
- Conduct interviews with key supervisory personnel and some subordinate employees.
- Observe and rate the organization and operation, including management of hazardous coating removal, technical capabilities, qualifications of personnel and safety, health, and environmental compliance.
- Examine and rate equipment and facilities.

The on-site audit will usually require from one to two days to complete.

**5.4 EXIT INTERVIEW:** Following the site audit, the auditor will hold an exit interview with a cognizant member of management. At the exit interview, the auditor will review observations and the evaluation with the contractor, including discussions of deficiencies and omissions, if any. A written schedule of deficiencies and omissions will be provided to the cognizant member of management, who will be asked to confirm receipt of the schedule. Every attempt is to be made by the auditor during the exit interview to explain why deficiencies were cited.

**5.5 EVALUATION OF APPLICATION AND DETERMINATION OF STATUS:** At the conclusion of the evaluation process, the auditor will make recommendations to the qualifying agency, which will make the final decision regarding applicant status.

**5.5.1 Qualification:** The auditor has determined that the contractor has met or exceeded the requirements of Section 4 above. The qualifying agency will make final determination of the contractor's qualification status based on the recommendation of the auditor and disciplinary or other evaluation criteria defined in the application materials. Upon acceptance of this recommendation, the qualifying agency will issue a certificate identifying the contractor by name and by location of the contractor's home office. Subsequent annual reconfirmation is subject to the qualifying agency's requirements.

**5.5.2 Withhold Qualification:** The auditor has determined that the contractor has not met the requirements of Section 4 above. Following any discussion necessary between the auditor and the qualifying agency, qualification may be withheld. If qualification is withheld, the qualifying agency shall provide to the contractor an itemization of deficiencies that led to the decision to withhold qualification. The contractor will be allowed 90 days after notification to submit corrective actions, and request an on-site re-audit.

**5.6 METHOD OF APPEAL:** If a contractor disputes the qualifying agency's decision, the contractor may appeal, utilizing the following steps of recourse:

- Notifying the qualifying agency within 10 working days after notification of audit results, specifically identifying reasons for the appeal.
- The contractor may arrange with the qualifying agency to have a second independent auditor acceptable to both parties brought in at the contractor's expense to inspect and re-evaluate the contractor for compliance with the standard's requirements.
- In the event the foregoing steps fail to resolve the dispute, a mutually agreed-upon arbitration panel, consisting of three persons familiar with contracting operations in the protective coatings industry, will hear evidence and make a final decision. If the arbitration panel finds for the contractor, the cost of all fees and expenses of the arbitration panel, the representative of the evaluation team, and the qualifying agency will be shared (50:50 split) by the contractor and the qualifying agency. If the arbitration panel does not find for the contractor, the contractor will be responsible for payment of all fees and expenses. Any other costs incurred by any party to the dispute will be borne by that party.

**5.7 RECONFIRMATION OF QUALIFICATION**

**5.7.1 Self-Audit:** The contractor shall at his own expense perform an annual self-audit, based on the requirements of Section 4 above, following initial qualification. The results of this self-audit will be retained on file by the contractor, and should be available to the auditor during any announced or unannounced audits, if requested.

**5.7.2 Reconfirmation of Qualification - Owner Comments:** Owners for whom the contractor performs work will be given an opportunity to comment on the qualified contractor's performance by completing an owner comment form provided by the qualifying agency. Comments will be in the form of replies to specific questions asked of owners regarding performance on specific jobs. Owner comments will be treated as confidential information.

**5.8 REVOCATION:** Failure to satisfactorily complete the annual self-audit or pass an audit to maintain qualification following initial qualification, or failure to meet disciplinary or other evaluation criteria established by the qualifying agency will be cause for suspension or revocation of certification. Audits conducted to determine continued qualification will be announced or unannounced and performed annually, unless otherwise determined by the qualifying agency.

**5.9. QUALIFICATION PERIOD:** Qualification is reviewed annually by the qualifying agency.

**5.10 QUALIFYING AGENCY FILES:** The qualifying

Provided by : www.spic.ir Licensee: NISOC Library

agency will maintain a list of certified contractors, as well as pertinent information submitted by owners and users who have utilized the contractor's services. This information will assist in the validation process during the qualification period.

All information gathered will be used only for purposes intended. Information determined to be proprietary in nature will be treated as confidential.

## 6. Disclaimer

While every precaution is taken to ensure that all information furnished in SSPC standards is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings or methods specified therein, or of the specification itself.

## 7. Notes

**7.1** SSPC has developed a "Standard Procedure For Evaluating Qualifications of Shop Painting Applicators" (SSPC-QP 3). In the future, additional qualification procedures may be established for linings and critical underwater service, and other specialized structures or industries.

## Appendix A. Additional References

The references below are listed for information only and do not constitute a part of this standard.

Title X - Lead Based Paint Reduction Act of 1992 and its Implementing Regulations 40 CFR 745 (Lead), Rule of Public Housing and Child Occupancy Facilities, Sept. 1996

Industrial Ventilation Manual: A Recommended Practice, (most recent edition), American Conference of Governmental Industrial Hygienists, 6500 Glenway, Building D-5, Cincinnati, OH, 45211.

ANSI/ASC Z9.4 — Ventilation and Safe Practice For Exhaust Systems Abrasive Blasting Operations, American National Standards Institute, 1430 Broadway, New York, NY 10018.

ANSI Z88.2 - 1992 — Practices for Respiratory Protection. American National Standards Institute.

## Appendix B. Common Sources for Information from EPA, OSHA and Others

### FEDERAL GOVERNMENT

These resources can also be found on SSPC Online (http://www.sspc.org/). Click on Links and then Government Information Sources.

- **Occupational Health and Safety Administration (OSHA):** Phone: 202-693-2200 On the Internet at http://www.osha.gov
- **Federal Information Center:** Phone Toll Free: 1-800-688-9889, open for public inquiries from 9:00 am to 8:00 pm ET, Monday through Friday. On the Internet at http:///www.fic.info.gov
- **Government Printing Office (GPO):** Orders and inquiries: 202-512-1800 On the Internet at http://www.access.gpo.gov/su_docs/db2.html. GPO sells government documents thorough mail order and government bookstores. Many are available in print or electronically. To find a local GPO bookstore check the Blue Pages of your local phone book.
- Selected government documents are available at depository libraries. There are approximately 14,000 depository libraries located throughout the country, which provide free access and professional assistance. Call your local library for assistance in locating a depository library near you.
- **Environmental Protection Agency (EPA):** General Information: 800-438-2474 On the Internet at http:/www.epahome/hotline/html - this will provide a list of phone numbers
- **Federal Highway Administration (FHWA):** Check the Blue Pages of your local phone book under United States Government to find an office near you. On the Internet at http://www.fhwa.dot.gov/. This site offers legislation and regulations online, as well as an electronic document library of portable document format (PDF) files.
- **National Lead Information Center:** 1-800-424-LEAD. On the Internet at http://www.nsc.org/ehc/lead.html.
- **Small Business Environmental Home Page:** 1-800-368-5888. Assists small business to comply with regulations, and provides information about cost saving pollution prevention practices. On the Internet at http://www.smallbiz-enviroweb.org/.

### STATE/REGIONAL CONTACTS

- Individual states may have their own environmental agencies, variously known as the Department of Environmental Protection, Department of Environmental Resources, Department of Natural Resources or state EPA. To obtain a phone number, look in the Blue Pages under State Government.
- NIOSH has occupational safety and health profiles for all states. You can access it on the Internet at http://www.cdc.gov/niosh/stateact.html.

Provided by : www.spic.ir Licensee: NISOC Library

**APPENDIX C**
**TABLES FROM SSPC-GUIDE 6**

## TABLE A - ABRASIVE BLAST CLEANING*
## COMBINATIONS OF CONTAINMENT AND VENTILATION SYSTEM COMPONENTS

| Containment Classification | Containment System (5.3 of SSPC-Guide 6) | | | | | Ventilation (5.4 of SSPC-Guide 6) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5.3.1 Containment Materials | 5.3.2 Penetrability | 5.3.3 Support Structure | 5.3.4 Joints | 5.3.5 Entryway | 5.4.1 Air Make-Up | 5.4.2 Input Air Flow | 5.4.3 Air Pressure | 5.4.4 Air Movement | 5.4.5 Exhaust Dust Filtration |
| Class 1A | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable | C1- Rigid<br>C2-Flexible | D1-Full Seal | E1-Airlock<br>E2-Resealable | F1-Controlled | G1-Forced | H-1 Instrument Verification | I1-Minimum Specified | J1-Air Filtration |
| Class 2A | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable | C1- Rigid<br>C2-Flexible | D1-Full Seal | E2-Resealable<br>E3-Overlap | F1-Controlled<br>F2-Open | G1-Forced<br>G2-Natural | H2-Visual Verification | I1-Minimum Specified | J1-Air Filtration |
| Class 3A | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable<br>B2-Air Penetrable | C1- Rigid<br>C2-Flexible | D1-Full Seal<br>D2-Partial Seal | E4-Open Seam | F1-Controlled<br>F2-Open | G1-Forced<br>G2-Natural | H3-Not Required | I2-Not Specified | J1-Air Filtration |
| Class 4A | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable<br>B2-Air Penetrable | C3-Minimal | D2-Partial Seal | E4-Open Seam | F2-Open | G2-Natural | H3-Not Required | I2-Not Specified | J2-No Controls on Exhaust |

Note 1: The information in this table is provided for guidance only and does not guarantee that any specific levels of containment will be achieved by following the suggestions. The type of structure, wind conditions, soundness of the materials of construction, and many other factors play a role in containing dust and debris.

Note 2: The table occasionally identifies two options for a given component. For example, containment materials (5.3.1) are shown as being either rigid or flexible. If the specifier requires the use of rigid materials only, this restriction must be specified separately.

Note 3: The design suggestions made in this table are based on the use of open abrasive blast cleaning inside containment. The classifications are ordered from the greatest degree of dust and debris containment (Class 1A). Normally, the higher the degree of containment, the higher the costs.

Note 4: Many other combinations of the components beyond those suggested above can be used to provide similar results. The method of preparation can also be adjusted to reduce or eliminate dust emissions.

Note 5: Certain combinations of components within each class may not be suitable when removing hazardous paints (e.g., forced air input in combination with penetrable containment materials in Class 3A).

Note 6: When designing a ventilation system, care must be taken to balance the static pressure with the input air flow to avoid collapsing the containment due to high negative pressure.

* When vacuum shrouded blast cleaning is employed, ground covers or free-hanging tarpaulins may provide controls equivalent to Class 1A.



Provided by : www.spic.ir Licensee: NISOC Library

## TABLE W - WATER BLASTING/WATER JETTING*
## COMBINATIONS OF CONTAINMENT AND VENTILATIONS YSTEM COMPONENTS

| Containment Classification | Containment System (5.3 of SSPC-Guide 6) | | | | | Ventilation (5.4 of SSPC-Guide 6) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5.3.1 Containment Materials | 5.3.2 Penetrability | 5.3.3 Support Structure | 5.3.4 Joints | 5.3.5 Entryway | 5.4.1 Air Make-Up | 5.4.2 Input Air Flow | 5.4.3 Air Pressure | 5.4.4 Air Movement | 5.4.5 Exhaust Dust Filtration |
| Class1W | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable<br>B3-Water Impermeable | C1-Rigid<br>C2-Flexible | D1-Full Seal | E2-Resealable | F2-Open | G1-Forced` | H2-Visual Verification | I1-Minimum Specified | J1-Filtration |
| Class 2W | A1-Rigid<br>A2-Flexible | B3-Water Impermeable | C1-Rigid<br>C2-Flexible | D1-Full Seal | E3-Overlap | F2-Open | G2-Natural | H3-Not Required | I2-Not Specified | J2-Not Required |
| Class 3W | A-1 Rigid<br>A-2 Flexible | B3-Water Impermeable | C3-Minimal | D2-Partial Seal | E4-Open | F2-Open | G2-Natural | H3-Not Required | I2-Not Specified | J3- Not Required |

Note 1: When designing a ventilation system, care must be taken to balance the static pressure with the input air flow to avoid collapsing the containment or ductwork due to high negative pressure.

Note 2: The table occasionally identifies two options for a given component. For example, containment materials (5.3.1) are shown as being either rigid or flexible. If the specifier requires the use of rigid materials only, this restriction must be specified separately.

* When vaccuum shrouded water jetting is employed, ground covers or free-hanging tarpaulins may provide controls equivalent to Class 1W.





Provided by : www.spic.ir Licensee: NISOC Library

## TABLE C - CHEMICAL STRIPPING
## COMBINATIONS OF CONTAINMENT AND VENTILATION SYSTEM COMPONENTS

| Containment Classification | Containment System (5.3 of Guide) | | | | | Ventilation (5.4 of Guide) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5.3.1 Containment Materials | 5.3.2 Penetrability | 5.3.3 Support Structure | 5.3.4 Joints | 5.3.5 Entryway | 5.4.1 Air Make-Up | 5.4.2 Input Air Flow | 5.4.3 Air Pressure | 5.4.4 Air Movement | 5.4.5 Exhaust Dust Filtration |
| Class 1C | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable<br>B4-Chemical Resistant | C1-Rigid<br>C2-Flexible | D1-Full Seal | E3-Overlap | F2-Open | G1-Forced | H3-Not Required | I2- Not Specified | J1-Filtration |
| Class 2C | A1-Rigid<br>A2-Flexible | B4-Chemical Resistant | C1-Rigid<br>C2-Flexible | D1-Full Seal | E3-Overlap | F2-Open | G2-Natural | H3-Not Required | I2-Not Specified | J2-Not Required |
| Class 3C | A1-Rigid<br>A2-Flexible | B4-Chemical Resistant | C3-Minimal | D2-Partial Seal | E4-Open Seam | F2-Open | G2-Natural | H3-Not Required | I2-Not Specified | J2-Not Required |

Note 1: When designing a ventilation system, care must be taken to balance the static pressure with the input air flow to avoid collapsing the containment or ductwork due to high negative pressure.

Note 2: The table occasionally identifies two options for a given component. For example, containment materials (5.3.1) are shown as being either rigid or flexible. If the specifier requires the use of rigid materials only, this restriction must be specified separately.



Provided by : www.spic.ir Licensee: NISOC Library

## TABLE P - POWER TOOL CLEANING*
## COMBINATIONS OF CONTAINMENT AND VENTILATION SYSTEM COMPONENTS

| Containment Classification | Containment System (5.3 of SSPC-Guide 6) | | | | | Ventilation (5.4 of SSPC-Guide 6) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5.3.1 Containment Materials | 5.3.2 Penetrability | 5.3.3 Support Structure | 5.3.4 Joints | 5.3.5 Entryway | 5.4.1 Air Make-Up | 5.4.2 Input Air Flow | 5.4.3 Air Pressure | 5.4.4 Air Movement | 5.4.5 Exhaust Dust Filtration |
| Class 1P | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable<br>B2-Air Penetrable | C1-Rigid<br>C2-Flexible | D1-Full Seal | E2-Resealable | F1-Combined | G1-Forced | H2-Visual Verification | I1-Minimum Specified | J1-Filtration |
| Class 2P | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable<br>B2-Air Penetrable | C1-Rigid<br>C2-Flexible | D1-Full Seal | E3-Overlap<br>E4-Open Seam | F2-Open | G2-Natural | H3-Not Required | I2-Not Specified | J2-Not Required |
| Class 3P | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable<br>B2-Air Penetrable | C3-Minimal | D2-Partial Seal | E4-Open Seam | F2-Open | G2-Natural | H3-Not Required | I2-Not Specified | J2-Not Required |

Note 1: When designing a ventilation system, care must be taken to balance the static pressure with the input air flow to avoid collapsing the containment or ductwork due to high negative pressure.

Note 2: The table occasionally identifies two options for a given component. For example, containment materials (5.3.1) are shown as being either rigid or flexible. If the specifier requires the use of rigid materials only, this restriction must be specified separately.

* For hand tool cleaning or vacuum shrouded power tool cleaning, ground covers or free-hanging tarpaulins may provide controls equivalent to Class 1P.





Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# QUALIFICATION PROCEDURE NO. 3

## Standard Procedure for Evaluating Qualifications of Shop Painting Applicators

## 1. Scope

**1.1** This standard procedure describes a method for evaluating the qualification of shops whose primary function is surface preparation and coating application services. However, the procedure may be applicable to a fabricating shop, shipyard, or other entity that applies coatings in the shop, even though providing coating application services is not its primary function.

**1.2** The procedure encompasses shop application of coatings in the industrial and light industrial/commercial market.

**1.3** In addition to the evaluation criteria outlined in this procedure, the qualifying agency may elect to review the applicant's financial status and performance history in more detail than required by this procedure.

**1.4** This standard is intended for work at fixed, permanent facilities. For field painting work that may involve the use of a temporary structure, evaluating contractors using SSPC-QP 1, "Standard Procedure for Evaluating Qualifications of Painting Contractors," is more appropriate.

## 2. Description

### 2.1 DEFINITIONS

**Applicator:** A firm that provides the complete range of coating application services (surface preparation through coating application) in a shop facility for the industrial and light industrial/ commercial markets

**Auditor:** 1) The person or persons who perform audits on behalf of the auditing agency or qualifying agency. 2) The body possessing the necessary technical competence to review applicant submittals, conduct on-site audits of applicants, and report results to the qualifying agency in compliance with the requirements of this procedure and the written requirements of the formal audit program.

**Covered Shop:** A permanent facility, enclosure or building having a roof under which cleaning and painting activities are normally performed out of direct exposure to outdoor weather.

**Enclosed Shop:** A permanent facility, enclosure or building (four walls to grade and a roof) where surface preparation and coating activities are normally conducted in an environment not subject to outdoor weather conditions and/or blowing dust. Note: It is to be understood that at times, in special cases, and with the approval of the party contracting the work, it may be necessary to clean or coat oversize pieces outside the enclosed shop.

**Field:** An open yard area, parking lot, or field where the environment is determined by ambient weather conditions.

**Open Shop:** A permanent area or facility with no roof or walls in which cleaning and painting activities are normally conducted. The area or facility is exposed to outdoor weather conditions and blowing dust.

**Owner:** The person, company or organization who owns the material upon which the shop facility is performing surface preparation and coating application.

**Procedure:** The sequence of steps taken to carry out a particular course of action.

**Qualification:** The objective evidence by which written assurance is given that an applicant conforms to the prescribed set of conditions or requirements of this standard procedure.

**Qualifying Agency:** The body responsible for development, maintenance, sponsorship and operation of a program to ensure uniform compliance with the provisions of this standard procedure.

**Shop Painting:** Conducting surface preparation and coating applications within a shop facility.

**2.2 FUNCTIONS TO BE EVALUATED:** The program has four function areas to be evaluated: Management Procedures, Technical Capabilities, Quality Control, and Safety, Health and Environmental Compliance. General requirements for each of these function areas are presented in Section 3.

**2.3 EVALUATION CRITERIA:** The qualifying agency must develop criteria or rating plans to evaluate each applicant against this standard. The qualifying agency shall also determine which of the specific, critical items within the four function areas are to be evaluated for subsequent follow-up or evaluations, ensuring the items evaluated are the same for all applicants. The sequence of steps for conducting an evaluation within a certification program is outlined in Section 4. The evaluation, in each instance, will be performed by the auditor.

**2.4 QUALIFICATION CATEGORIES:** This standard establishes three qualification categories for shop painting: enclosed shop, covered shop, and open shop. These categories differ to the extent of the shop's capability to conduct surface preparation and coating operations without regard to ambient weather conditions.

Provided by : www.spic.ir Licensee: NISOC Library

## 3. General Qualification Requirements

**3.1 MANAGEMENT PROCEDURES:** The applicant must demonstrate adequate procedures for disseminating company policy and for personnel, administrative and financial management as follows:

**3.1.1 Company Policy**

a. General mission statement with separate declarations on quality control and safety processes, goals and commitments.

b. Description of procedures for disseminating company policies within the organization.

**3.1.2 Organization and Personnel**

a. Organizational chart showing division of responsibility within the company.

b. List of names, titles, duties, and job descriptions for key personnel (management, technical, quality control, safety) involved in purchasing and handling of materials related to coatings or surface preparation, as well as those involved in surface preparation and coating operations, such as inspection and testing.

c. List of in-house or external training courses and written career advancement programs attended by key personnel.

**3.1.3 Administrative and Management Procedures**

a. Brief description of company method of financial record keeping.

b. Procedures used to review job specifications and other related bid documentation.

c. Formal procedures for complying with federal, state, and local environmental, health, and safety regulations.

**3.2 TECHNICAL CAPABILITIES:** The applicant must show evidence of having qualified personnel, adequate technical resources, suitable job conversion procedures, and appropriate equipment, facilities, and experience as follows:

**3.2.1 Personnel Qualifications**

a. Availability of training programs.

b. Qualifications of personnel performing surface preparation and application, including certifications for applying specialized materials.

c. Monitoring of surface preparation and application personnel for proficiency.

**3.2.2 Technical Resources**

a. List of technical societies, trade associations, or other industry groups (e.g., universities, major manufacturers, consultants) with which shop is associated.

b. Verifiable evidence that the company maintains a library of current documents appropriate for certification category sought.

**3.2.3 Procedures:** Description of procedures which are used to convert job specifications into shop work orders, job plans, etc., including:

a. Written records of receipt and processing of job specifications and revisions.

b. Procedures for receipt of specifications and revisions.

c. Procedures for clarifying ambiguous specifications.

d. Procedures for communicating specifications and shop procedures to quality control and production supervisors.

**3.2.4 Experience, Equipment, and Facilities**

a. Listing of current and recently completed jobs and work experience which support company's capabilities to perform work at the level of certification sought. List should include the following:

- Facility name, address, telephone and fax numbers, and principal contact.
- Description of work performed, including: materials applied with name and address of manufacturers; equipment used; project and shift supervisor's name(s) and number of painters required per shift; special safety or environmental requirements or provisions; approximate volume of product applied; and delivery method of the completed work.

b. List of equipment used for cleaning, surface preparation, coating application, curing, and material handling and delivery.

c. Written maintenance and repair procedures for equipment and vehicles, as well as maintenance records

d. Provide written preventive maintenance plans for major equipment (e.g., air make up units, centrifugal blast equipment, blast cabinets, dust collectors, compressors, pollution control equipment) and evidence of use of such plans.

e. Description of the shop's capability to control environmental conditions and pollutants. This would include describing each area with environmental or pollution controls, the nature of these controls, and functions carried out in the specific area. Such areas include (1) prior-to-cleaning material storage, (2) pre-cleaning, (3) preparation, (4) equipment maintenance, (5) application of coating and (6) curing. The description of the areas would include ventilation, lighting, dust control, and physical dimensions depending upon qualification category sought.

f. Shop must maintain area adequate for storage of coating materials in accordance with manufacturer's requirements and governing safety regulations. At a minimum, flammable materials should be stored in approved containers; storage area temperature should be maintained in accordance with manufacturer's recommendations or overriding safety regulations; paint and solvent should be stored under cover and out of direct sunlight; storage area should have operable fire extinguishers and explosion-proof lighting; smoking should be prohibited; mixing of paints should be prohibited in the storage area; paint with expired shelf life should be segregated from current material; storage area should be kept neat and orderly, free of

Provided by : www.spic.ir Licensee: NISOC Library

accumulation of empty paint cans, combustibles and other debris.

**3.3 QUALITY CONTROL:** The applicant must demonstrate that it has qualified personnel, inspection equipment, and proper inspection and recording procedures for job quality control.

**3.3.1 Personnel Qualifications**

a. Documentation that personnel performing quality control functions are qualified, including records of training and experience of qualified supervisor and inspectors, and a description of qualification requirements for inspectors.

b. Documentation that quality assurance personnel report directly to management, other than production supervisor, and evidence that quality control inspectors have authority to stop work which is found to be nonconforming.

**3.3.2 Inspection Procedures and Recording Systems**

a. Records of standards and specifications for coating inspection work and their utilization.

b. System for maintaining and filing in-process and final inspection reports.

c. Availability of inspection equipment to monitor surface preparation and application.

d. Demonstration that procedures are available and used for:

- calibration of inspection instruments
- consistent inspection of each major operation (i.e., coating materials receipt, materials inspection, materials storage, surface preparation; application of primer, intermediate and topcoat; pre-shipping and shipping damage)
- providing adequate light for inspection as well as free access to all items being inspected
- stopping work not conforming to specification
- identifying and isolating non-conforming material
- identifying and correcting problems with inspection equipment, procedures, and personnel

**3.4 SAFETY, HEALTH AND ENVIRONMENTAL COMPLIANCE:** The submitted application must document proper health and safety and environmental compliance procedures and recordkeeping systems and access to resource material as follows:

**3.4.1 Safety Procedures**

a. Documentation of safety education, safety meetings, regular safety inspections, and other relevant activities. Verification that shop has adequate written safety program and that program rules are consistently monitored and enforced.

b. Pre-job safety planning.

c. Documentation of accident reports, including investigation to determine cause as well as actions taken to prevent recurrence.

d. Procedure for determining proficiency of safety and loss control measures shop utilizes.

e. Safety procedures for specialized equipment.

f. Verification that controls and procedures exist to ensure sufficient ventilation following NFPA guidelines during surface preparation and coating operations are in place.

g. Verification that controls and procedures exist to avoid encroachment of other operations in surface preparation and coating areas.

h. Verification that housekeeping measures are in place to control hazards.

i. Verification that procedures for safe wiring, adequate grounding and proper general electrical practices following NFPA guidelines are in place.

j. Verification that appropriate respirators and other personal protective equipment are provided, properly used and properly maintained.

k. Availability of first-aid trained employees.

**3.4.2 Environmental Compliance**

a. Verification that shop has an adequate written environmental compliance program to handle processing and proper disposal of hazardous waste and that program rules are consistently monitored and enforced.

**3.4.3 Resource Materials**

a. List of available resource materials.

b. Sources of information on safety requirements.

c. Procedures used for acquiring safety information and materials.

d. Availability of safety information referenced in submittals.

e. Material Safety Data Sheets (MSDS).

## 4. Application and Qualification Procedures

**4.1 SUBMITTAL OF WRITTEN APPLICATION PACKAGE:** The initial step is to request an application form and instructions. The request, along with an application fee (when applicable) must be submitted to the qualifying agency.

The application process involves gathering required information on the firm as described in the application form. This information and documentation will be submitted to the qualifying agency at the same time as the formal application for qualification.

**4.2 REVIEW OF APPLICATION PACKAGE:** The applicant's application package is reviewed by the qualifying agency using guidelines for evaluation which have been established by that agency. The evaluation items are based on Section 3 of this document.

**4.3 ON-SITE AUDIT OF APPLICANT:** Subject to satisfactory evaluation of the application package referred to in 4.2 and on a date mutually agreed upon by the applicant and the qualifying agency, an auditor representing the auditing agency will visit the applicant's premises to investigate and rate the following areas directly and indirectly affecting quality of work provided: Management Procedures, Technical Capabilities, Quality Control, and Safety,

Provided by : www.spic.ir Licensee: NISOC Library

Health, and Environmental Compliance. The auditor will perform the following:

- Confirm data submitted with the application for qualification.
- Conduct interviews with key supervisory personnel and some subordinate employees.
- Observe and rate the organization and operation, including management procedures; technical capabilities; quality control; and safety, health, and environmental compliance procedures.
- Examine and rate equipment and facilities.

The on-site audit will usually require from one to two days to complete.

**4.4 EXIT INTERVIEW:** Following the site audit, the auditor will hold an exit interview with a cognizant member of management. At the exit interview, the auditor will review observations and the evaluation, including discussions of deficiencies and omissions, if any. A written schedule of deficiencies and omissions will be provided to the cognizant member of management, who will be asked to confirm receipt of the schedule. Every attempt is to be made by the auditor during the exit interview to explain why deficiencies were cited.

**4.5 EVALUATION OF APPLICATION AND DETERMINATION OF STATUS:** At the conclusion of the evaluation process, the auditor will make recommendations to the qualifying agency, which will make the final decision regarding applicant status:

**4.5.1 Qualification:** The auditor has determined that the applicant has met or exceeded the requirements of Section 3 above. The qualifying agency will make final determination of the applicant's qualification status based on the recommendation of the auditor and disciplinary or other evaluation criteria defined in the application materials. Upon acceptance of this recommendation, the qualifying agency will issue a certificate identifying the applicant by name and by location of the applicant's home office. Subsequent annual reconfirmation is subject to the qualifying agency's requirements.

**4.5.2 Withhold Qualification:** The auditor has determined that the applicant has not met the requirements of Section 3 above. Following any discussion necessary between the auditor and the qualifying agency, qualification may be withheld. If qualification is withheld, the qualifying agency shall submit to the applicant an itemization of deficiencies that resulted in the decision to withhold qualification. The applicant will be allowed 90 days after notification to submit corrective actions and request an on-site re-audit.

**4.6 METHOD OF APPEAL:** If an applicant disputes the qualifying agency's decision, the applicant may appeal, utilizing the following steps of recourse:

- Notifying the qualifying agency within 10 working days after notification of audit results, specifically identifying reasons for the appeal.
- The applicant may arrange with the qualifying agency to have a second independent auditor acceptable to both parties brought in at the applicant's expense to inspect and re-evaluate the applicant for compliance with the standard's requirements.
- In the event the foregoing steps fail to resolve the dispute, a mutually agreed-upon arbitration panel, consisting of three persons familiar with shop application operations in the coatings industry, will hear evidence and make a final decision. If the arbitration panel finds for the applicant, the cost of all fees and expenses of the arbitration panel, the representative of the evaluation team, and the qualifying agency will be shared (50:50 split) by the applicant and the qualifying agency. If the arbitration panel does not find for the applicant, the applicant will be responsible for payment of all fees and expenses. Any other costs incurred by any party to the dispute will be borne by that party.

**4.7 RECONFIRMATION OF QUALIFICATION**

**4.7.1 Self-Audit:** The applicant shall at his own expense perform an annual self-audit, based on the requirements of Section 3 above, following initial qualification. The results of this self-audit will be forwarded to the qualifying agency, with a copy retained on file by the applicant, and will be made available to the auditor during any announced or unannounced audits.

**4.7.2 Owner Comments:** Owners for whom the applicant performs work will have an opportunity to comment on the qualified applicator's performance by completing an owner comment form available from the qualifying agency. Comments will be in the form of replies to specific questions asked of owners regarding performance on specific jobs. Owner comments will be treated as confidential information.

**4.8 REVOCATION:** Failure to satisfactorily complete the annual self-audit or pass an audit to maintain qualification following initial qualification, or failure to meet disciplinary or other evaluation criteria established by the qualifying agency, will be cause for suspension or revocation of certification. Audits conducted to determine continued qualification will be announced or unannounced and performed annually, unless otherwise determined by the qualifying agency.

**4.9 QUALIFICATION PERIOD:** Qualification is for three years with annual reviews as determined by the qualifying agency.

**4.10 QUALIFYING AGENCY FILES:** The qualifying agency will maintain a list of certified applicators, as well as pertinent information submitted by owners and users who have utilized the applicator's services. This information will assist in the validation process during the qualification period.

Provided by : www.spic.ir Licensee: NISOC Library

All information gathered will be used only for purposes intended. Information determined to be proprietary in nature will be treated as confidential.

## 5. Disclaimer

While every precaution is taken to ensure that all information furnished in SSPC guides and standards is as accurate, complete, and useful as possible, SSPC cannot assume any responsibility, nor incur any obligation, resulting from the use of any materials or methods specified therein, or of the procedure itself.

## 6. Note

The American Institute of Steel Construction (AISC, 1 East Wacker Drive, Suite 3100, Chicago, IL 60601-2001) administers a Quality Certification Program with an optional Sophisticated Paint Endorsement certification for steel fabrication shops. The Sophisticated Paint Endorsement certification parallels the requirements outlined in Sections 3.1 (Management Procedures), 3.2 (Technical Capabilities) and 3.3 (Quality Assurance and Control) of this standard procedure. SSPC accepts the AISC/SPE as an equal to QP 3, with the exception of safety, health, and environmental compliance.

## Appendix - Guidelines for Evaluating Applicant Submittals and for Rating Items Evaluated During the On-site Evaluation Audit

**Applicant Submittals -** The Qualifying Agency (QA) should identify written submittal items required by the applicant prior to the audit. Examples of such items include: written quality control program; written safety, health and environmental compliance program and enforcement procedures; names and titles of key management and supervisory personnel; applicator training programs; references; worker compensation Experience Modification Rate (EMR); accident and injury log.

The submittal package can include other items as required by the qualifying agency reviewing the applicant's submittal.

**Auditing Criteria** - Once the application and submittals are completed, the qualifying agency (QA) can arrange for the on-site audit to determine whether the applicant meets the requirements of this standard procedure.

Before conducting the audit, the QA must develop a set of acceptable responses to each evaluation item to be used by the auditor during the audit. A rating system such as 1, 2, 3 can be developed to assign points for each item rated. For example, a rating of "1" can be assigned for items rated below the acceptable response. A "2" rating can be given for items that meet the criteria.

Pass/fail scoring criteria can be established to determine whether an applicant has met the qualification requirements. Taking this one step further, the QA can also set required scores for certain critical items it deems essential to the qualification. For example, SSPC requires applicants to obtain an acceptable rating for the "Safety Program and Enforcement" evaluation item.

Another approach to rating each item is to require that the applicant meet the acceptable response for all items. If the applicant falls short on any item, the auditor can issue a major or minor deficiency which must be corrected in a specified period of time (e.g., 90 days) in order for the applicant to achieve qualification. A "minor" deficiency may be defined as a system or procedure less than two-thirds implemented. Corrective action could be submitted in writing and accepted as a remedy to achieve an "acceptable" response. A "major" deficiency may be defined as a system or procedure less than one- third implemented. Corrective action for "major" deficiencies might require a written statement identifying the correction followed by an on-site audit if the item rated is deemed critical by the qualifying agency.

**CRITICAL EVALUATION ITEMS (SHOP)**

**1. Technical Capabilities**

- Are blasters and painters adequately trained?
- Is there a procedure for recording specifications and revisions?
- Does shop have and follow a process for clarifying ambiguous specifications?
- Is there a procedure for communicating job/shop procedures to QC and production personnel?
- Are there areas available in the shop for specific operations, such as: receiving and lay down for pipe, steel, etc., to be coated; pre-cleaning of items to be coated; preparation of items to be coated; surface preparation; coating application; drying and curing of coated materials; storage of coating materials, etc.?

**2. Quality Control**

- Is there documentation that personnel performing quality control related functions (supervisor and inspectors) are qualified, including records of training and experience? Are there written qualification requirements for inspectors?
- Do quality control personnel report directly to management and have authority to stop non- conforming work or order corrective rework?
- Are there standards and specifications available and used by quality control personnel in conjunction with inspections, as needed?
- Are inspection reports and other required records documenting compliance with customer requirements maintained?

Provided by : www.spic.ir Licensee: NISOC Library

- Do quality control inspectors have necessary inspection equipment and calibration standards to inspect work?
- Can quality control inspectors demonstrate history of identifying and isolating non-conforming work and material as well as stopping work if necessary? Are non conformances and corrective actions documented?

**3. Safety, Health and Environmental Compliance**

- Does shop have adequate written safety and health compliance programs? Are procedures in the programs implemented and enforced (e.g. routine safety assessments; disciplinary measures)? Are safety information and required procedures disseminated to employees?
- Is there an adequate hazard communication program?
- Is appropriate personal protective equipment issued and properly maintained?

**QP 3 SCORING**

- SSPC determines qualification based on the shop's total score, which is derived by multiplying Response Ratings for each evaluation item by the Assigned Value for that item, and totalling the resulting weighted response ratings for all evaluation items.
- Response Ratings define the quality of the shop's response to each evaluation item as follows:

| Rating | Interpretation | (Definition) |
|---|---|---|
| 0 | Non-Responsive | (No answer, or one with no connection to the question) |
| 1 | Unsatisfactory Response | (pertinent but inadequate answer) |
| 2 | Satisfactory Response | (minimally acceptable response) |
| 3 | Superior Response | (exceeds minimum acceptable) |

- Assigned Values reflect the relative importance of each evaluation item as follows:

| Value | Interpretation |
|---|---|
| 1 | Important |
| 2 | Very Important |
| 3 | Extremely Important |

- The shop's score is compiled on the Evaluation Report Form and Tally Sheet utilized by the auditor. Copies are sent to the shop 30-45 days after the audit is complete.
- To pass the QP 3 evaluation the shop must meet all three of the following:
  - achieve a minimum "2" rating on all Critical Items
  - achieve an overall passing score
  - achieve a passing score for each function area (e.g., Management Procedures; Technical Capability; Quality Control; and Safety, Health and Environmental Compliance).

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-QP 4
May 1, 1997
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# QUALIFICATION PROCEDURE NO. 4

## Standard Procedure for Evaluating the Qualifications of Contractors Disturbing Hazardous Coatings During Demolition and Repair Work

## 1. Scope

**1.1** This standard establishes a procedure for evaluating the qualifications of contractors whose work involves disturbance of hazardous coatings (e.g., containing lead or other hazardous metals) incidental to demolition or repair work on complex or conventional structures.

**1.2** This standard establishes two qualification categories for contractors disturbing and containing hazardous paint. The specifying agency shall designate the required qualification category for the contractor based on the type and level of containment and ventilation required.

**1.3** This standard procedure also establishes minimum requirements for worker health and safety programs and environmental protection programs utilized by the contractor who disturbs hazardous coatings incidental to demolition or repair work.

**1.4** Contractors qualified under SSPC-QP 2 already meet the requirements of this standard procedure.

## 2. Description

### 2.1 DEFINITIONS

**Competent Person:** One who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, the public, and the environment, and who has authorization to take prompt corrective measures to eliminate them. OSHA requires a competent person on-site during exposure-producing operations.

**Complex Structure:** Complex structures are those constructed of steel or concrete, such as metal producing and rolling mills, bridges, and processing facilities, including chemical and petrochemical processing plants, pulp and paper mills, power plants and substations, and food and beverage plants and terminals.

**Contractor:** A firm that performs general construction (i.e., demolition and repair work) in the industrial and commercial markets.

**Conventional Structures:** Structures such as light manufacturing plants; miscellaneous and ornamental iron work; sign structures; storage tanks; low rise, truss, beam, and column structures. Simple rolled beam bridges may also be covered by the requirements of this standard procedure.

**Evaluating Authority:** A facility owner or authority designated by the facility owner to review contractor submittals, conduct on-site evaluations and report results of the evaluation determining if the contractor is in compliance with the requirements of this procedure.

**Hazardous Coatings:** Coating systems that contain substances (e.g., lead or other hazardous metals) in sufficient concentrations to create an occupational hazard for the worker exposed to or handling the coating waste, or an environmental hazard in the locale where disturbance of the coating is taking place.

**Limited Amounts:** Only the minimum amount of paint that should be removed from localized areas to meet regulations for: flame cutting of existing steel for the purpose of demolition; arc gouging to disconnect existing steel members; welding of new steel members to existing members; welds for the retrofitting of bearings, etc.

**Qualification:** The procedure by which written assurance is given that an applicant conforms to the prescribed set of conditions or requirements of this standard procedure.

**Subcontractor:** For the purposes of this qualification procedure, the term “subcontractor” is interchangeable with the term “contractor” and is defined as the same.

### 2.2 FUNCTIONS TO BE EVALUATED

**2.2.1** The qualification process rates four areas: 1) Management of Hazardous Paint Removal; 2) Technical Capabilities; 3) Qualification of Personnel; and 4) Safety Health, and Environmental Compliance. Specific requirements (evaluation items) for each of these areas are presented in Section 4 of this standard procedure. For special requirements, additional evaluation items may be included.

**2.2.2** The evaluating authority shall develop specific criteria, scoring, and evaluation schemes for determining the qualifications of all contractors based on the evaluation items in Section 4. For special requirements, additional evaluation items may be included.

Provided by : www.spic.ir Licensee: NISOC Library

2.2.3 The criteria, scoring, and evaluation schemes constitute the "Evaluation Guidelines" used to determine a contractor's qualifications, using the sequence of procedures in Section 5 of this standard procedure.

**2.3 QUALIFICATION CATEGORIES**

**2.3.1** This standard procedure establishes two qualification categories for removing and containing hazardous (e.g., lead-based) paint. These categories differ in the extent of containment and ventilation required, based on the amount of dust and debris likely to be generated during repair and demolition. Note: This standard procedure is primarily geared toward lead paint removal work. However, if chromium or other hazardous materials are present in the previously applied coating system, the contractor is expected to be familiar with OSHA and EPA requirements for handling these materials.

**2.3.2 Category A:** This category consists primarily of chemical stripping and power tool cleaning within containment in accordance with Class 1C or 1P of SSPC-Guide 6. Contractors qualifying for Category A automatically qualify for Category B.

**2.3.3 Category B:** This category consists primarily of chemical stripping and power tool cleaning within containment in accordance with Class 2C, 3C, 2P or 3P of SSPC-Guide 6. Qualification for Category B does not automatically include qualification for Category A.

## 3. References

**3.1** The standards and references listed in Sections 3.4 through 3.6 form a part of this standard procedure.

**3.2** The latest issue, revision, or amendment of these standards and other references shall govern unless otherwise noted.

**3.3** If there is a conflict between the requirements of any of the references and this procedure, the requirements of the procedure shall prevail.

**3.4 SSPC STANDARDS:**

**Guide 6** Guide for Containing Debris Generated During Paint Removal Operations

**Guide 7** Guide for the Disposal of Lead-Contaminated Surface Preparation Debris

**QP 2** Standard Procedure for Evaluating the Qualifications of Painting Contractors to Remove Hazardous Paint

**3.5 U.S. GOVERNMENT CODE OF FEDERAL REGULATIONS:**

**29 CFR, Part 1926** Safety and Health Regulations for Construction"

**40 CFR, Part 50** Appendix G, "NationalAmbient Air Quality Standard for Lead"

**40 CFR, Subchapter I** "Solid Wastes" (parts 260-263 and 268)

**3.6 U.S. DEPARTMENT OF LABOR, OCCUPATIONAL HEALTH & SAFETY ADMINISTRATION (OSHA):**

OSHA Guidelines on Workplace Safety and Health Program Management (Issued as 54 FR 3904, January 26, 1989)

OSHA Instruction CPL 2-2.58, Inspection and Compliance Procedures for 29 CFR 1926.62, Lead Exposure in Construction, Interim Final Rule

## 4. Qualification Requirements

The contractor shall meet the requirements of 4.1 through 4.4.

**4.1 MANAGEMENT OF HAZARDOUS PAINT REMOVAL**

**4.1.1 Contractor's Company Policy:** The company mission or policy statement shall state in writing that the contractor is committed to the protection of workers and the public from occupational and environmental hazards associated with disturbance of lead-based or other hazardous paint during demolition or repair work. The contractor should take steps to protect domestic and wild animals, fowl, and fish. The contractor must also present the policy to all employees verbally to reinforce the spirit of the contractor's mission and ensure that employees who cannot read English understand it.

**4.1.2 Authority and Responsibility of Competent Persons**

**a. Authority:** The "competent person," as defined in sections 2.1 and 4.3.1, shall have the complete support of top management and the written authority to ensure that operations are carried out in accordance with compliance plans and governmental regulations, independent of production pressures. To ensure independence, competent persons shall report directly to a manager not involved with production. The competent person may have additional responsibilities and carry out other work assignments, but shall not routinely be a production member of the work crew.

**b. Responsibility:** The competent person shall be responsible for overseeing hazardous paint removal opera-

Provided by : www.spic.ir Licensee: NISOC Library

tions. Responsibilities shall include:

1. Monitoring effectiveness and ensuring the continued integrity of environmental controls.
2. Monitoring worker exposure or overseeing monitoring activities performed by others.
3. Ensuring that a hazard communication program and other applicable training has been conducted for the contractor's personnel on site.
4. Ensuring that employees working in the exposure area are wearing personal protective equipment and are trained in the use of such equipment and in the use of exposure control methods, personal hygiene facilities, respiratory protection, and decontamination practices.
5. Ensuring that the engineering controls in use are in operating condition and functioning properly.
6. Ensuring that fugitive emissions to air, water, or soil are minimized and that handling of all waste streams is in compliance with applicable regulations and contract specifications.
7. Ensuring that regulated areas are marked off and controlling access to them.
8. Maintaining project documentation, such as exposure assessment results, ventilation performance checks, respirator fit tests, personal monitoring results, results of site safety inspections, medical surveillance results, etc., in accordance with the programs required in Section 4.4.

**4.1.3 Information Resources:** The contractor shall identify a source for obtaining information on relevant regulations pertaining to hazardous paint removal and industrial hygiene procedures. A reference file of information shall be maintained at the job site or be readily accessible. (See Section 4.2.5 for types of references.)

**4.2 TECHNICAL CAPABILITIES**

**4.2.1 Qualification Categories:** The contractor shall meet the requirements for the qualification category specified (see Section 2.3). The requirements for qualification categories A and B are given in Sections 4.2.2 and 4.2.3. Note: In addition to the requirements given in Sections 4.2.2 and 4.2.3, the contractor must also meet all the other requirements of this standard procedure.

**4.2.2 Requirements for Category A:** The contractor shall demonstrate competence in the following:

- Protecting, storing, and labeling hazardous materials and waste (see Section 4.6.1).
- Operation, maintenance, and safety when using water jetting, wet abrasive blast, dry abrasive blast, power tool cleaning or other coating removal equipment.
- Coating removal using containment and ventilation that meets the requirements of Class 1A or 2A, or 1W or 1P of SSPC-Guide 6.
- Operation, maintenance, and safety when using abrasive or water recovery equipment.
- Maintaining employee exposures below the appropriate OSHA Permissible Exposure Limit (PEL) first through use of engineering and work practice controls to the extent that such controls are feasible and secondarily through use of respiratory protection that complies with current OSHA regulations.
- Coating removal using containment and ventilation that meet the requirements of Class 1C or 1P of SSPC-Guide 6
- Assessing quantity of emissions and worker exposure.

**4.2.3 Requirements for Category B:** The contractor shall demonstrate competence in the following:

- Protecting, storing, and labeling hazardous materials and waste (see Section 4.4.2).
- Operation, maintenance, and safety when using chemical stripping equipment and materials, power tools, or other paint removal equipment.
- Maintaining employee exposures below the appropriate OSHA Permissible Exposure Limit (PEL) first through use of engineering and work practice controls to the extent that such controls are feasible and secondarily through use of respiratory protection that complies with current OSHA regulations.
- Coating removal using containment and ventilation that meet Class 2C, 3C, 2P, or 3P of SSPC-Guide 6.
- Assessing quantity of emissions and worker exposure.

**4.2.4 Verifying Qualification Categories:** Contractors shall submit evidence of successfully meeting the specification requirements of hazardous paint removal jobs, using environmental controls in accordance with the owner's specifications. Evidence shall include documentation of hazardous paint removal jobs in which the contractors are currently involved or that they have completed in the last 24 months. Documentation shall include the following.

a. Description of the jobs, including:
   - Facility name, address, and principal contact.
   - Brief description of structure and work performed, including dates on site.
   - Method used to disturb paint.
   - Environmental controls used.
   - Types of containment and ventilation used, if applicable.
   - Portion of project specification dealing with safety, health, and environmental control.
   - Name of competent person on site.

b. Verification of successful completion of the jobs described, including compliance with applicable federal, state, and local regulations enforceable during the project.

Provided by : www.spic.ir Licensee: NISOC Library

**4.2.5 Technical Library:** The contractor shall have an up-to-date library of industrial and governmental resources on subjects related to hazardous paint removal, including:

a. Relevant federal, state, and local occupational safety and health standards, regulations, compliance directives, and guidelines.
b. Ventilation standards and procedures, if applicable.
c. Relevant federal, state, and local environmental regulations regarding solid and hazardous waste and on air, water, and soil quality.
d. Containment guidelines and technical data sheets (e.g., equipment operating manuals).
e. Applicable paint removal methods.
f. Waste collection, handling, and disposal guidelines.
g. Industrial hygiene and safety practices.

**4.3 PERSONNEL QUALIFICATIONS AND TRAINING**

**4.3.1. Competent Person Training and Experience:** Evidence or documentation shall be furnished that the competent person has had at least 24 hours of training and has the experience described below in Section 4.3.1.b. NOTE: Proposed Environmental Protection Agency (EPA) regulations may require more than 24 hours of training to comply with Title X.

a. Training of the competent person shall include:
   1. Relevant hazardous and solid waste handling procedures.
   2. Relevant portions of the following regulations and standards: 1) National Ambient Air Quality Standards (NAAQS); 2) OSHA Construction Industry Standards; 3) EPA solid and hazardous waste regulations; 4) EPA site clean-up and spill response regulations; and 5) relevant state and local regulations.
   3. Different removal methods, classes of containment, and environmental controls consistent with one or more of the qualification categories specified in Section 4.2.
   4. All aspects of training specified in Section 4.3.2.
   5. Relevant safety practices outlined in Section 4.4.
   6. Annual refresher training, at a minimum of eight hours per year.
b. Experience of the competent person shall include:
   1. Minimum of two years of related experience.
   2. Experience in relevant safety practices.
   3. Experience in waste handling procedures relative to projects described in Section 4.2.
   4. Experience in environmental monitoring relative to projects described in Section 4.2.

**4.3.2 Production and Support Worker Training:** Evidence or documentation shall be furnished that production and support personnel (i.e., those involved in hazardous paint removal operations or related work) shall have had at least eight hours of training annually. Note: Proposed EPA regulations may require more than eight hours of training in the future; at a minimum, the training program shall include the following:

a. Contents of 29 CFR 1926.21, 1926.59, 1926.62, and any EPA regulations in effect to comply with Title X.
b. Awareness of the types of operations with lead or other hazardous materials that could result in exposure exceeding the action levels. If no action level exists, use half of the Permissible Exposure Limit (PEL) as the threshold.
c. Procedures for handling hazardous materials and waste.
d. Contents of the contractor's general and site-specific written compliance plans, as required in Section 4.4.

**4.4 REQUIRED WORKER PROTECTION AND ENVIRONMENTAL COMPLIANCE PROGRAMS**

**4.4.1 Worker Protection Procedures and Recordkeeping Systems:** The contractor shall have on site a written worker protection plan based on the applicable requirements of 29 CFR 1926.62 (Construction Industry) and OSHA and National Institute for Occupational Safety and Health (NIOSH) lead in construction guidelines and compliance directives. This program shall include, at a minimum:

a. Defined responsibilities for a safety coordinator, who shall have training in industrial hygiene and safety. This person may be on the contractor's staff, or the contractor may utilize the services of an industrial hygiene or safety professional with knowledge of hazardous paint removal operations. Since the competent person is required to be on site to implement all compliance activities, it is not necessary for the safety coordinator to be on site at all times. However, the safety coordinator should be available for consultation as needed.
b. Evidence that the written worker protection plan has been reviewed and approved by an industrial hygiene or safety professional.
c. Provisions for exposure monitoring.
d. Details of hazardous materials compliance plan, including provisions for:
   1. Protective clothing
      - working clothes provided by employer
      - laundry provided by employer
      - changing work clothes prior to leaving the work site
   2. Housekeeping
      - delineation of clean and contaminated areas
      - delineation and usage of equipment storage areas

Provided by : www.spic.ir Licensee: NISOC Library

- periodic dust and waste clean up

3. Hygiene
   - hand-washing facilities
   - showers with separate clean and contaminated areas for clothing storage and changing
   - separate worker break and eating areas

4. Medical surveillance
   - pre- and post-job blood testing and physical
   - periodic blood testing
   - medical removal protection in accordance with OSHA
5. Training
   - use of equipment
   - use and maintenance of respirators
   - safety, such as the use of scaffolding, eye and ear protection, and signs
6. Recordkeeping
   - OSHA 200 log
   - medical surveillance
   - exposure monitoring
   - training

e. Respiratory protection and medical surveillance program
f. Employee site-specific training

**4.4.2 Environmental Compliance Plan:** The contractor shall have a written plan to protect the environment from hazardous materials located at the job site. This plan shall include, at a minimum:

a. An environmental protection plan detailing how the contractor controls discharges to air, soil, and water.
b. A hazardous waste materials management and disposal plan. (See SSPC-Guide 7 and 40 CFR, Subchapter 1, "Solid Wastes" parts 260-263 and 268.)

**4.4.3 Monitoring Plan:** The contractor shall have a written procedure specifying monitoring criteria and a resulting action plan for the competent person. The plan shall require the competent person to be on site at all times (unless otherwise authorized) during paint-disturbing operations. Instructions shall require this person, independent of production pressures, to stop non-conforming operations (i.e., work that deviates from the safety and environmental compliance programs). This procedure shall also provide for a qualified back-up person in the event that the competent person is absent from the job site.

**4.4.4 Enforcement:** The contractor shall document that procedures and policies are in effect to ensure that the worker safety and environmental plans are enforced.

## 5. Determining Qualifications

**5.1 CONTRACTOR SUBMITTALS:** The contractor seeking qualification shall submit to the evaluating authority written documentation of the firm's qualifications with respect to all items addressed in Section 4. These must include the following, at a minimum:

a. Experience of contractor in operations that result in disturbance of hazardous paint or related work.
b. Names of representatives of facility owners or prime contractors for whom work was performed, and dates of work.
c. Evidence that the contractor has designated specific individuals as competent persons who are qualified to supervise hazardous paint removal or related work.
d. Specific training and certification of production and support personnel in the environmental and health risks associated with disturbance of hazardous paint, and in industrial hygiene.
e. Other evidence of effectiveness of programs and qualifications outlined in Sections 4.1 through 4.4 (e.g., OSHA 200 log and blood lead level monitoring records).
f. Copies of safety and environmental compliance programs.
g. Copies of citations issued to the contractor for serious or willful violations of federal, state, or local regulations.

**5.2 REVIEW WRITTEN MATERIAL SUBMITTED:** The following steps shall be followed by the evaluating authority to determine the accuracy of written materials:

**5.2.1** Compare contractor submittals with criteria listed in Sections 4.1 through 4.4.

**5.2.2** Identify any criteria for which additional information is needed.

**5.2.3** Obtain, or direct contractor to obtain, additional information on items identified in Section 5.2.2. Such information may be gathered by calling owner or prime contractor references, training organizations, or other knowledgeable services.

**5.3 OPTIONAL ON-SITE EVALUATION:** The evaluating authority may choose the option of visiting the contractor's permanent office, a job site representative of the contractor's capabilities, or both, to verify information provided in the submittal. The verification process may include examination of field records and interviews with managers, supervisors, workers, and owner's representatives about specific

Provided by : www.spic.ir Licensee: NISOC Library

safety and technical procedures, training, and operations conducted by the applicant which resulted in disturbance of hazardous paint during demolition or repair work.

**5.4 COMPUTE FINAL RATING:** Based on criteria established in Section 4 and evaluations in Section 5.2 (and 5.3 if this option is exercised), determine whether the contractor meets minimum ratings of the functions evaluated to achieve qualification.

**5.5 NOTIFY APPLICANT:** Review the results of the evaluation with the contractor, including discussion of omissions. Inform the contractor whether the firm has met the authority's qualification requirements. If the contractor has not met requirements, advise of corrective actions and establish time for implementation.

**5.6 CONFIRMATION OF QUALIFICATION:** Once qualified, the contractor meeting the requirements of this procedure must be re-evaluated annually by the evaluating authority, depending upon criteria set up by the facility owner or evaluating authority.

**5.7 REVOCATION:** Failure to pass the aforementioned periodic re-evaluation, submit required corrective actions from a previous evaluation in a timely manner, or submission of false or misleading information shall be cause for revocation of certificate of qualification.

## 6. Disclaimer

While every precaution is taken to ensure that all information furnished in SSPC documents is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any methods specified therein, or of the standard procedure itself.

## Appendix A. Additional References

The references below are listed for information only and do not constitute a part of this standard procedure.

ANSI/ASC Z9.4 — Ventilation and Safe Practice For Exhaust Systems Abrasive Blasting Operations, American National Standards Institute, 1430 Broadway, New York, NY 10018.

ANSI Z88.2 - 1992 — Practices for Respiratory Protection. American National Standards Institute.

Code of Federal Regulations: 40 CFR, Part 745, Lead; Requirements for Lead-based Paint Activities: Proposed Rule (found in Federal Register, Vol. 59, No. 170, September 2, 1994, pps. 45872-45921).

Industrial Ventilation Manual: A Recommended Practice (most recent edition), American Conference of Governmental Industrial Hygienists, 6500 Glenway, Building D-5, Cincinnati, OH 45211.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# QUALIFICATION PROCEDURE NO. 5

## Standard Procedure for Evaluating Qualifications of Coating and Lining Inspection Companies

### 1. Scope

**1.1** This standard procedure provides guidelines for evaluating and qualifying coating and lining inspection companies. The process described in this procedure may be verified by the purchaser of the services or by an independent agency.

**1.2** The objective of this procedure is to confirm that an inspection company has the personnel, organization, qualifications, procedures, knowledge, and capability to provide comprehensive protective coating inspection services to end users of protective coatings.

**1.3** The procedure encompasses the inspection of protective coatings for new construction and maintenance in industrial, commercial, and marine applications.

**1.4** Meeting the requirements of this procedure does not guarantee the performance of individual inspectors or a specific inspection company.

### 2. Definitions

**Auditing Agency:** The body that possesses the necessary technical competence to review applicant submittals, conduct on-site audits of applicants, and report results to the qualifying agency for compliance with this procedure's requirements.

**Calibration:** The set of operations that establish, under specified conditions, the relationship between values indicated by a measuring instrument and the corresponding known values of a measurement.

**Coating:** A liquid, liquefiable, or mastic composition that is converted to a solid protective, decorative, or functional adherent film after application as a thin layer.

**Coating Inspection Company:** An independent company which is not involved in the manufacture of coating materials or coating application equipment, or the application process, whose primary function is to inspect the application process and the quality of the applied film.

**Inspection:** Confirmation by examination and provision of evidence that specified requirements have been met. The examination and determination of conformity with specific requirements on the basis of professional judgment, and general requirements according to published industry standards, as required in each project specification.

**Lining:** A material used to protect a container against corrosion or to protect the contents of the container from contamination by the container shell material.

**Qualifying Agency:** The body responsible for sponsorship and operation of a program to ensure uniform compliance with provisions of this standard procedure

**Quality Control Manual:** A document stating the quality policy, quality system and quality practice of an organization.

**Quality System:** The organizational structure, responsibilities, procedures, processes and resources for implementing quality management.

**Test:** A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, physical phenomenon, process or service, according to a specified procedure.

**Test Method:** Defined technical procedure for performing a test.

**Verification:** Confirmation by examination and provision of evidence that specified requirements have been met.

### 3. Significance and Use

**3.1** Inspection companies meeting the requirements of this standard procedure comply in practice and methods with generally accepted inspection criteria for coating inspection and field testing activities normally required as a part of coating inspection work. Inspection companies meeting the requirements of this standard procedure provide and maintain the necessary inspection instruments required for each project.

Provided by : www.spic.ir Licensee: NISOC Library

## 4. Organization and Management

**4.1** The inspection company shall be legally identifiable (e.g., a corporation, proprietorship, partnership, etc.) based on the laws where the business is located.

**4.1.1** An inspection body that is part of an organization involved in functions other than inspection shall be an identifiable unit within that organization.

**4.2** The inspection company shall:

**4.2.1** Demonstrate that managerial staff have the necessary expertise, authority and resources to review and verify work performed by field personnel by supplying (1) an organizational chart clearly showing lines of authority within the company, (2) written documentation of training and experience of managerial staff, and (3) written evidence that management periodically reviews work performed by its field personnel.

**4.2.2** Be organized in such a way that confidence in its independence of judgment and integrity is maintained at all times. Provide written evidence that verification of the inspection result is administered independently of the inspection operation.

**4.2.3** Specify and document the responsibility, authority, and interrelation of all personnel who manage, perform or verify work affecting the quality of inspections and tests. Demonstrate that management personnel review work of field inspection staff to ensure compliance with project specifications and any other contract documents.

**4.2.4** Provide supervision by persons familiar with the inspection or test methods and procedures, the objective of the inspection or test, and the assessment of the results. (See Section 6 for a description of qualification requirements for inspectors.)

**4.2.5** The manager of the inspection company shall provide written evidence of training at a minimum equivalent to that required of an SSPC Certified Protective Coating Specialist, or a NACE Certificated Inspector; or shall hold a B.S. degree in corrosion science or corrosion engineering.

The training should include, but not be limited to, the following:

a. corrosion theory
b. coating types and characteristics
c. surface preparation techniques and equipment
d. coating application techniques and equipment
e. coating inspection/instrumentation
f. physical methods of coating evaluation

**4.2.7** The inspection company shall have a manager with executive responsibility to ensure compliance with all company quality procedures and their implementation. This manager shall either be the owner or president of the company or shall have a direct reporting relationship to the owner or president of the company. This relationship must be accurately reflected on the organizational chart and be demonstrable in fact.

**4.2.8** Appoint designated replacements in case of absence of the technical or quality manager. The designated replacements shall demonstrate qualifications as required by 4.2.5 above, and in the absence of the manager shall report directly to the company president or CEO.

**4.2.9** Have documented policy and procedures to ensure the confidentiality of clients' information and proprietary rights. The company shall demonstrate, by written examples of enforcement activities, that its policies with respect to confidentiality of client information and proprietary rights are current and enforced.

## 5. Quality System, Audit and Review

**5.1** The inspection company shall establish and maintain a quality system appropriate to the type, range and volume of inspection activities it undertakes. The elements of this system shall be documented. The quality documentation shall be available for use by inspection company personnel. The inspection company shall define and document its policies and objectives for and its commitment to good quality management inspection company practice. The inspection company management shall ensure that these policies and objectives are documented in a quality control manual and communicated to, understood by, and implemented by all inspection company personnel. The quality control manual shall be current and the quality manager shall be responsible for maintaining it. The inspection company shall maintain a written internal audit file illustrating compliance by all company personnel at all levels with the quality control manual. Jobs audited during the internal audit shall be reflected in this file.

**5.2** In order to meet the requirements of this standard procedure, the quality control manual and related quality documentation shall state the inspection company's policies and operational procedures. The quality control manual and related quality documentation shall also contain:

**5.2.1** A quality policy statement, including objectives and commitments, by top management.

**5.2.2** The organization and management structure of the inspection company, its place in any parent organization and relevant organizational charts.

Provided by : www.spic.ir Licensee: NISOC Library

**5.2.3** The reporting relationship between management, technical operations, support services and the quality system.

**5.2.4** Procedures for control (including distribution) and maintenance of all quality control procedures and corporate record keeping and retention policies.

**5.2.5** Job descriptions of key staff and reference to the job descriptions of other staff.

**5.2.6** Identification of the inspection company's approved signatories (where this concept is appropriate).

**5.2.7** The inspection company's procedures for achieving traceability of measurements.

**5.2.8** The inspection company's general scope of inspections and tests. (The precise scope of an inspection will be determined by the terms of the individual contract or work order.)

**5.2.9** Appropriate and clear reference to the inspection, verification and test procedures to be used.

**5.2.10** Procedures for performing inspections and tests.

**5.2.11** Reference to any inspection equipment and reference measurement standards used.

**5.2.12** Reference to procedures for inspection, calibration, verification and maintenance of equipment as required.

**5.2.13** Reference to proficiency testing programs, use of reference materials and internal quality control schemes.

**5.2.14** Procedures to be followed for feedback and corrective action whenever inspection or testing discrepancies are detected, or whenever departures from documented policies and procedures occur. All corrective actions shall be documented in writing.

**5.2.15** The treatment of exceptions to documented policies and procedures. All exceptions shall be documented in writing.

**5.2.16** Procedures for dealing with client complaints. All client complaints shall be documented in writing and corrective actions shall also be documented in writing.

**5.3** The inspection company shall schedule either internal or external audits of its activities at appropriate intervals to verify that its operations continue to comply with the requirements of the quality system. All audit findings, whether internal or external, shall be documented in writing. Such audits shall be carried out by trained and qualified staff who are independent of the activity to be audited. Where the audit findings cast doubt on the correctness or validity of the inspection company's inspections or test results, the inspection company shall take immediate corrective action and shall notify, in writing, any client whose work may have been affected.

**5.4** The quality system adopted to satisfy the requirements of this standard procedure shall be reviewed at least once a year and the review shall be documented in writing by the management to ensure its continuing suitability and effectiveness and to introduce any necessary changes or improvements.

**5.5** All internal audit and review findings and any corrective actions that arise from them shall be documented in writing. The person responsible for quality shall ensure by written verification that these actions are discharged within the agreed time.

**5.6** In addition to periodic internal audits the inspection company shall ensure the quality of results provided to clients by implementing periodic checks. These checks shall be reviewed by the president or CEO who shall verify in writing the following:

**5.6.1** Written internal quality control procedures using, whenever possible, statistical techniques.

**5.6.2** Participation in proficiency testing or other qualification programs.

**5.6.3** Use of certified reference materials or in-house quality control using secondary reference materials.

**5.6.4** Replica inspection or testing.

**5.6.5** Supervisory review of inspection results.

## 6. Personnel[1]

**6.1** The inspection company shall have personnel with the necessary education, training, physical capabilities, technical knowledge and experience for their assigned functions.

### 6.2 PHYSICAL QUALIFICATIONS OF INSPECTORS

**6.2.1** Each inspector shall be examined annually to ensure natural or corrected near-distance visual acuity in at least one eye. The individual shall read the J-1 letters on a

[1] Material in this section is based on requirements of ASTM D 4537, Standard Guide for Establishing Procedures to Qualify and Certify Inspection Personnel for Coating Work in Nuclear Facilities.



Provided by : www.spic.ir Licensee: NISOC Library

Standard Jaeger Test Chart, or equivalent, at a distance of not less than 12 in. with one or both eyes, corrected or uncorrected.

**6.2.2** Each inspector shall be examined annually for color perception using the Ishihara Test or the Farnsworth D-15 Test. If a candidate does not pass the Red/Green Sensitive Ishihara Test, the candidate may take the Farnsworth D-15 Test.

**6.2.3** If an inspector does not pass the Farnsworth D-15 Test, the inspector may be evaluated by a licensed medical practitioner to provide the necessary data to determine the inspector's color perception. Individuals certified after an evaluation by a licensed medical practitioner may only be certified to perform inspection work that is within the inspector's color perception capability.

**6.2.4** The examinations required by 6.2.1 and 6.2.2 shall be administered by a licensed medical practitioner or a person familiar with the tests involved. The results of the vision test shall be documented on a Vision Test Record.

**6.2.5** The responsible organization shall identify any other physical qualifications required to perform the assigned inspection duties. Inspectors requiring the identified physical qualifications shall have them confirmed by examinations at intervals not to exceed one year.

**6.3 EDUCATION AND EXPERIENCE REQUIREMENTS.** The inspection company shall have in place a documented program for qualification and training of its personnel. This policy shall allow for the definition of at least three levels of personnel, as follows:

**6.3.1** Level I Coatings Inspectors shall be capable of the following:

- Implementing and recording all inspections required by the procedures described in Section 5.2.8
- Verifying instrument calibration
- Performing hold point inspections in accordance with the procedures described in Section 5.2.8

**6.3.1.1** Level I Coatings Inspectors shall, as a minimum, meet one or more of the following education requirements:

- High school diploma plus six months of satisfactory performance in inspection activities equivalent to those described in Section 6.3.1
- Associate Degree or higher, plus three months of related experience in inspection activities equivalent to those described in Section 6.3.1

**6.3.2** Level II Coatings Inspectors shall be capable of performing all the duties and responsibilities of a Level I Coatings Inspector. In addition, the Level II Coatings Inspector shall be capable of the following:

- Planning and supervising inspections, initiating and reviewing inspection procedures, and evaluating the adequacy of activities
- Reviewing, organizing and approving results of inspections
- Monitoring the performance of and supervising the work of Level I Coatings Inspectors
- Training and verifying the qualifications of Level I Coatings Inspectors for certification
- Initiating changes to quality procedures
- Implementing the Quality Assurance Program

**6.3.2.1** Level II Coatings Inspectors shall, as a minimum, meet one or more of the following education requirements:

- High school diploma plus one year of satisfactory performance as a Level I Coatings Inspector in the activities described in Section 6.3.1
- High school diploma plus three years of related experience in activities as described in Section 6.3.1
- Associate Degree plus one year of related experience in inspection activities as described in Section 6.3.1
- B.A. or B.S. degree plus six months of related experience in inspection activities as described in Section 6.3.1

**6.3.3** Level III Coatings Inspectors shall be capable of carrying out all of the duties and responsibilities of a Level II Coatings Inspector. In addition, the Level III Coatings Inspector shall be capable of the following:

- Certifying Level I and Level II Coatings Inspectors
- Responsible for evaluating the adequacy of programs used to train Coatings Inspectors
- Responsible for authorizing Level II Coatings Inspectors to carry out training and examination duties
- Responsible for approving all safety-related inspection procedures

**6.3.3.1** Level III Coatings Inspectors shall meet one or more of the following educational requirements:

- High school diploma plus six years of satisfactory performance as a Level II Coatings Inspector in the activities described in 6.3.2
- High school diploma plus ten years of related experience in inspection activities as described in Section 6.3.2; or
- High school diploma plus eight years experience in equivalent inspection activities, with at least two years as a Level II Coatings Inspector
- Associate Degree and seven years of related experience in inspection activities as described in Sec-

Provided by : www.spic.ir Licensee: NISOC Library

tion 6.3.2

- B.A. or B.S. degree plus five years of related experience in equivalent inspection activities as described in Section 6.3.2.

Level III inspectors shall be certified by members of the upper level management of the inspection company who meet the minimal education and experience requirements defined in Section 6.3.3 and 6.3.3.1.

See Table 1 for a summary of the skill and education requirements for Level I, Level II and Level III inspectors.

**Table 1**
**Summary of Skill and Education Requirements for Level I, II and III Inspectors**

| LEVEL I SKILLS | LEVEL II SKILLS | LEVEL III SKILLS |
|---|---|---|
| Implement and record inspection activities | Plan and supervise inspections | Certify Level I and Level II Inspectors |
| Verify calibration of inspection instruments | Review inspection procedures | Evaluate adequacy of inspector training programs |
| | Evaluate adequacy of inspection activities | Authorize Level II Inspectors to carry out training and examination duties |
| | Review and approve inspection results | Approve all safety-related inspection procedures |
| | Monitor performance of Level I inspectors | Perform all duties and responsibilities of a Level II Inspector |
| | Verify qualifications of Level I inspectors | |
| | Initiate changes to quality procedures | |
| | Implement a Quality Assurance Program | |
| | Perform all duties and responsibilities of a Level I inspector | |

| LEVEL I EDUCATION | LEVEL II EDUCATION | LEVEL III EDUCATION |
|---|---|---|
| High school diploma plus 6 months experience in Level I skills | High school diploma plus 1 year experience in Level II skills plus qualified as a Level I inspector | High school diploma plus 6 years of Level II qualification |
| Associate degree or better plus 3 months experience in Level I skills | High school diploma plus 3 years experience in duties of Level I inspector | High school diploma plus 10 years of Level II experience (not necessarily qualified as Level II) |
| | Associate degree or better plus 1 year experience in duties of a Level I inspector | High school diploma plus 8 years Level II experience and 2 years Level II qualification |
| | B.S./B.A. plus 6 months experience in duties of Level I inspector | Associate degree plus 7 years Level II experience |
| | | B.S./B.A. plus 5 years Level II experience |

Provided by : www.spic.ir Licensee: NISOC Library

**6.3.4** Additional classifications of personnel may be defined by the inspection company.

**6.4** The company shall have in its written policy a requirement for training qualifications at each level or technical society participation to keep the inspector qualified at a given level.

**6.5** Records on the relevant qualifications, training, skills and experience of the inspection personnel shall be maintained by the inspection company. These records shall be made available to employees and to clients upon request. Written records of disclosure to clients shall be maintained.

## 7. Equipment and Equipment Reference Materials

**7.1** The inspection company personnel shall be furnished all items and equipment, including reference materials, required for the performance of inspections and tests. If the inspection company uses equipment outside its permanent control, it shall ensure that the equipment meets the requirements listed below.

**7.2** All equipment shall be properly maintained. Maintenance procedures shall be documented. Instruments which have been subjected to mishandling, or which give suspect results, or have been shown by verification or otherwise to be defective, shall be taken out of service, clearly identified and stored at a specified place until they have been repaired and shown by calibration, verification or test to perform satisfactorily. The inspection company shall examine the effect of this defect on previous inspections or tests.

**7.3** Calibration records shall be maintained for each instrument. The records shall include:

**7.3.1** The name of the instrument.

**7.3.2** The manufacturer's name, type identification, and serial number or other unique identification.

**7.3.3** Date the instrument was received and date it was placed in service.

**7.3.4** Current location of the instrument.

**7.3.5** Condition of the instrument when received (e.g., new, used, reconditioned).

**7.3.6** Manufacturer's operating and calibrating instructions for the instrument.

**7.3.7** Dates and results of the instrument's calibration and date that the next calibration should be performed.

**7.3.8** Details of maintenance procedures carried out to date and planned for the future.

**7.3.9** History of any damage, malfunction, modification or repair.

## 8. Measurement Traceability and Calibration

**8.1** All measuring and testing equipment having an effect on the accuracy or validity of inspections or tests shall be calibrated before being put into service. The inspection company shall have an established procedure for the calibration and verification of its measuring and test equipment.

**8.2** The overall procedure of calibration shall be designed and operated so as to ensure that, wherever applicable, measurements made by the inspection company are traceable to national standards of measurement. Calibration certificates shall indicate the traceability to nationally recognized standards.

**8.3** Where traceability to nationally recognized standards is not applicable, the inspection company shall provide evidence of correlation of results.

**8.4** Where relevant, reference standards and measuring and testing equipment shall be subjected to in-service checks between calibrations.

## 9. Inspection Methods and Practices

**9.1** All instructions, standards, manuals and reference data relevant to the work of the inspection company shall be up-to-date and readily available to management and users. The inspection company shall maintain records demonstrating that individual inspectors have received and understand written instructions for the use and calibration of inspection equipment.

**9.1.1** The individual inspectors shall have copies of and be familiar with specific job site specifications, specific product data sheets, material safety data sheets (MSDS) as appropriate, and applicable job site documents and standards for work being inspected for compliance.

**9.2** The inspection company shall use appropriate methods and procedures for all inspections, tests and related activities within its responsibility (including sampling, handling, transport and storage, preparation of items, estimation of uncertainty of measurement, and analysis of inspection or test data). The methods and procedures shall be consistent with the accuracy required, and with any

Provided by : www.spic.ir Licensee: NISOC Library

standard specifications relevant to the inspections or tests concerned.

**9.3** Where methods are not specified, the inspection company shall, wherever possible, select methods that have been published in nationally recognized standards, such as those published by reputable technical organizations (e.g., SSPC, NACE, ASTM) or in relevant scientific texts or journals.

**9.4** Where it is necessary to employ methods that have not been established as standard, these shall be subject to agreement with the client and coating manufacturer, be fully documented and validated, and be available to the client and other recipients of the reports.

**9.5** Where sampling is carried out as part of the test method, the inspection company shall use documented procedures and appropriate statistical techniques to select samples.

**9.6** Calculations and data transfers shall be subject to appropriate checks.

**9.7** Where computers or automated equipment are used for the recording, processing, manipulation, reporting, storage or retrieval of calibration or inspection data, the inspection company shall ensure that:

**9.7.1** Procedures are established and implemented for protecting the integrity of data; such procedures shall include, but not be limited to, integrity of data entry or capture, data storage, data back-up and replication, data transmission and data processing.

**9.7.2** Computer and automated equipment is maintained to ensure proper functioning and provided with the environmental and operating conditions necessary to maintain the integrity of calibration and test data.

## 10. Traceability of Records and Reports

**10.1** The inspection company shall have a documented system for identifying the structure or equipment to be inspected or tested, to ensure that there can be no confusion regarding the identity of such items at any time.

**10.2** The coatings inspection company shall give evidence of adequate procedures for insuring quality of inspection and support activities as follows:

**10.2.1** Inspection procedures and recording systems.

**10.2.2** Procedures for receipt of specifications and revisions.

**10.2.3** Records of standards and specifications or coating inspection work records and their utilization.

**10.2.4** System for filing, distribution, storing and retrieving of inspection reports.

**10.2.5** Availability of inspection equipment and calibration standards and procedures.

**10.2.6** Procedures to ensure that each major significant activity (e.g., surface preparation, coating application, and curing of primer, intermediate and topcoat application) is inspected and documented.

**10.2.8** Procedures to verify that specified steps are taken in storing, handling, and applying coatings, in compliance with OSHA, EPA, state, and local regulations.

**10.3** The inspection company shall maintain a record system to suit its particular circumstance and comply with any applicable regulations. It shall retain on record all original observations, calculations and derived data, calibration records and a copy of the calibration certificate, or inspection report, for an appropriate period. The records for each inspection and test shall contain sufficient information to permit their repetition. The records shall include the identity of personnel involved in sampling, preparation, inspection or testing.

**10.4** All records (including those pertaining to calibration and test equipment), certificates and reports shall be safely stored, held secure and in confidence to the client.

## 11. Certificates and Reports

**11.1** The results of each inspection, test, or series of inspections or tests carried out by the inspection company shall be recorded in a written report accurately and objectively, in accordance with any instructions in the inspection or test methods. The results should be recorded in a report and should include all the information necessary for the interpretation of the inspection or test results and all information required by the method used.

**11.2** Each report shall include at least the following information:

**11.2.1** A descriptive title.

**11.2.2** Name and address of inspection company, and location where the inspection was carried out.

**11.2.3** Identification of the instrumentation (such as serial number).

Provided by : www.spic.ir Licensee: NISOC Library

**11.2.4** Name and address of client.

**11.2.5** Name and address of coating application company.

**11.2.6** Description and clear identification of the structure or equipment inspected.

**11.2.7** Description of the test area and results of the inspection or test.

**11.2.8** Date of inspection.

**11.2.9** Identification of the inspection or test method used, or clear description of any non-standard method used.

**11.2.10** Reference to sampling procedure, where relevant.

**11.2.11** Any deviations from, additions to or exclusions from the inspection or test method, and any other information relevant to a specific inspection or test, such as environmental conditions.

**11.2.12** Measurements, examinations and derived results, supported by tables, graphs, sketches and photographs as appropriate, and any failures identified.

**11.2.13** A signature and title, or an equivalent identification of the persons accepting responsibility for the content of the report and date of issue.

**11.2.14** Where relevant, a statement to the effect that the results relate only to the items inspected or tested.

**11.2.15** A statement that the report shall not be reproduced except in full, without the written approval of the inspection company.

**11.3** Where the report contains results of inspections or tests performed by sub-contractors, these results shall be clearly identified.

**11.4** Particular care and attention shall be paid to the arrangement of the report, especially with regard to presentation of the inspection or test data and ease of use by the reader.

**11.5** The inspection company shall notify clients promptly, in writing, of any event that casts doubt on the validity of results given in any inspection report or amendment to a report.

**11.6** The inspection company shall ensure that, where clients require transmission of inspection or test results by telephone, telex, facsimile or other electronic or electromagnetic means, staff will follow documented procedures to assure that the requirements of this standard procedure are met and that all reasonable precautions are taken to maintain confidentiality.

## 12. Sub-contracting of Inspection or Testing

**12.1** Where an inspection company subcontracts any part of the inspection or testing, this work shall be placed with an inspection company fully complying with the requirements imposed in Sections 1-14 of this document. The inspection company shall ensure and be able to demonstrate that its sub-contractor is competent to perform the activities in question and complies with the same criteria of competence as the inspection company. The inspection company shall advise the client in writing in advance of its intention to sub-contract any portion of inspection or testing to another party. Written client approval shall be obtained where required.

**12.2** The inspection company shall record and retain details of its investigation of the competence and compliance of its sub-contractors and maintain a register of all subcontracting.

## 13. Outside Support and Supplies

**13.1** Where the inspection company procures outside services and supplies, other than those referred to in this standard procedure, in support of inspections or tests, the inspection company shall use only those outside support services and supplies that are of adequate quality to sustain confidence in the inspection company's inspections or tests.

**13.2** Where no independent assurance of the quality of outside support services or supplies is available, the inspection company shall have procedures to ensure that purchased equipment, materials and services comply with specified requirements. The inspection company should, wherever possible, ensure that purchased equipment and consumable materials are not used until they have been inspected, calibrated or otherwise verified as complying with any standard specifications relevant to the inspections or tests concerned.

**13.3** The inspection company shall maintain records of all suppliers from whom it obtains support services or supplies required for inspections or tests.

## 14. Complaints

**14.1** The inspection company shall have documented policy and procedures for the resolution of complaints received from clients or other parties about the inspection company's work. A record shall be maintained of all complaints and of the actions taken by the inspection company.

Provided by : www.spic.ir Licensee: NISOC Library

**14.2** Where a complaint, or any other circumstance, raises doubt concerning the inspection company's compliance with its policies or procedures, or with the requirements of this standard or otherwise concerning the quality of its inspections or tests, the inspection company shall ensure that those areas of activity and responsibility involved are promptly audited in accordance with Section 5 of this procedure.

## 15. Sequence of Procedures

**15.1 SUBMITTAL PROCEDURE FOR APPLICATION:** The initial step is to request an application form and instructions. The request, along with an application fee (when applicable), must be submitted to the qualifying agency.

The application process involves gathering required information about the inspection company as described in the application form. This information and documentation will be submitted to the qualifying agency at the same time as the formal application for qualification.

**15.2 REVIEW WRITTEN MATERIAL SUBMITTED:** The following steps shall be followed by the qualifying agency to determine the accuracy of written materials:

**15.2.1** Compare applicant submittals with criteria listed in Sections 4 through 13 for the inspection company's written procedures for quality assurance, performance of inspection activities, education and qualifications of personnel, instrument maintenance and calibration, and reporting and recordkeeping.

**15.2.2** Identify any criteria for which additional information is needed.

**15.2.3** Obtain, or direct applicant to obtain, additional information on items identified in Section 15.2.2.

**15.3 OPTIONAL ON-SITE EVALUATION:** The qualifying agency may choose the option of visiting the inspection company's office to verify information provided in the submittal. The verification process may include examination of records and interviews with supervisory personnel and some subordinate employees about specific technical and quality assurance procedures, training, and inspection operations conducted by the inspection company.

**15.4 COMPUTE FINAL RATING:** Based on criteria established in Sections 4 through 13 and evaluations in Sections 15.2 (and 15.3 if this option is exercised), determine whether the inspection company meets minimum ratings of the functions evaluated to achieve qualification.

**15.5 NOTIFY APPLICANT:** Review the results of the evaluation with the inspection company, including discussion of omissions. Inform the inspection company whether the firm has met the qualifying agency's qualification requirements. If the inspection company has not met requirements, advise of corrective actions and establish time for implementation.

**15.6 CONFIRMATION OF QUALIFICATION:** Once qualified, the inspection company meeting the requirements of this procedure must be re-evaluated periodically by the qualifying agency.

**15.7 REVOCATION:** Failure to pass the aforementioned periodic re-evaluation, submit required corrective actions from a previous evaluation in a timely manner, or submission of false or misleading information shall be cause for revocation of certificate of qualification.

## 16. Disclaimer

While every precaution is taken to insure that all information furnished in SSPC standards is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any methods or procedure specified therein, or of the standarditself.

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC: The Society for Protective Coatings

# GUIDE 6

## Guide for Containing Debris Generated During Paint Removal Operations

## 1. Scope

**1.1** This guide describes methods of paint removal, containment systems and procedures for minimizing or preventing emissions from escaping the work area, and procedures for assessing the adequacy of the controls over emissions.

**1.2** The containment systems are categorized in up to four classes per type of paint removal method, based on the extent to which emissions are controlled.

**1.3** This guide is primarily intended for use with steel structures; however, some of the methods and materials may be suited for use on concrete, aluminum, wood, or other materials of construction.

**1.4** This guide is intended to be used by facility owners, specifiers, designers, and contractors. It may also be used by other interested parties.

**1.5** A discussion of ventilation is included in the guide to assist users in both controlling emissions to the environment, and in enhancing worker protection and visibility within the containment. It is important to recognize that ventilation systems alone may or may not be sufficient to fully protect workers when the paint being removed contains lead or other toxic metals, and additional work practice and/or administrative controls and respiratory protection may be required to control worker exposures. Requirements or evaluation methods for worker health and safety are outside the scope of this guide.

## 2. Description and Definitions

**2.1 GENERAL:** During surface preparation, airborne particulate and debris from the removal of paint (particularly paints containing lead, cadmium, and chromate pigments) can contaminate the air, soil, and water surrounding work sites. The potential environmental hazards are reduced by minimizing or eliminating the airborne particulate, and by containing and collecting the debris. Controlling airborne particulate and other emissions may be necessary to comply with Federal, state, and local regulations.

**2.2 OUTLINE OF GUIDE**

**2.2.1 Procedures Included in this Guide:**

- Selecting Methods of Surface Preparation and Debris Collection (Section 4.1)
- Specifying Containment Systems (Section 4.2)
- Selecting Methods for Assessing the Quantity of Emissions (Section 4.3)
- Implementing Containment Project (Section 4.4)

**2.2.2** The guide also includes descriptions and commentaries on:

- Methods of Coating Removal (Section 5.1)
- Methods of Collecting Debris (Section 5.2)
- Containment Enclosure Components (Section 3)
- Ventilation System Components (Section 5.4)
- Methods for Assessing Quantity of Emissions (Section 5.5)
- Methods of Assessing Efficiency of Debris Collection and Bulk Abrasive Recovery (Section 5.)

**2.3 DEFINITIONS**

**2.3.1 Action Level for Lead:** Employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air (30 $\mu g/m^3$) calculated as an eight-hour TWA per OSHA General Industry Standard 29 CFR 1910.1025 and OSHA Construction Industry Standard 29 CFR 1926.62.

**2.3.2 Containment System:** A containment system includes the cover panels, screens, tarps, scaffolds, supports, and shrouds used to enclose an entire work area or a paint removal tool. The purpose is to minimize or prevent the debris generated during surface preparation from entering into the environment, and to facilitate the controlled collection of the debris for disposal. Containment systems may also employ the use of ground covers or water booms.

**2.3.3 Ventilation System:** Ventilation systems include both natural ventilation and mechanical ventilation (fans, hoods, and duct work), to provide air movement across the work area, and dust collectors to clean the discharged air.

**2.3.4 PM-10:** Particulate matter (dust) less than 10 micrometers (0.39 mils) in aerodynamic equivalent diameter. (Aerodynamic equivalent diameter is defined as the diameter of a unit density sphere having the same settling velocity as the particle in question, regardless of its shape and density.)

**2.3.5 Permissible Exposure Limit (PEL) for Lead:** Maximum allowable employee average exposure per OSHA General Industry Standard 29 CFR 1910.1025 and OSHA Construction Industry Standard 29 CFR 1926.62.

Provided by : www.spic.ir Licensee: NISOC Library

**2.3.6 Time Weighted Average (TWA):** Concentrations of airborne toxic materials which have been weighted for a certain time duration, usually eight hours.

**2.3.7 Impenetrable:** Impervious to dust and wind.

**2.3.8 Impermeable:** Impervious to water.

## 3. Referenced Documents

**3.1** The standards and references in this guide are listed in Sections 3.2 through 3.9 and form a part of this guide.

**3.2** The latest issue, revision, or amendment of the reference standards in effect on the date of invitation to bid shall govern unless otherwise stated.

Note: New governmental regulations or amendments to existing ones become effective as scheduled by the governmental agency, independent of the date of bid.

**3.3 SSPC: THE SOCIETY FOR PROTECTIVE COATINGS:**

| | |
|---|---|
| **AB 2** | Specification for Cleanliness of Recycled Ferrous Metallic Abrasives |
| **PA Guide 5** | Guide to Maintenance Painting Programs |
| **Guide 7** | Guide for the Disposal of Lead Contaminated Surface Preparation Debris |

**3.4 U. S. GOVERNMENT CODE OF FEDERAL REGULATIONS:**

| | |
|---|---|
| **29 CFR 1926.62** | Interim Final Rule on Lead Exposurein Construction |
| **29 CFR 1910.1025** | Occupational Safety and Health Standards (Lead) |
| **40 CFR, Part 50, Appendix G** | National Ambient Air Quality Standard for Lead |

**3.5 U. S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (NIOSH):**

**Method 7082** Lead

**3.6 U. S. DEPARTMENT OF LABOR, OCCUPATIONAL HEALTH AND SAFETY ADMINISTRATION**

**OSHA 3142** Lead in Construction

**3.7 U. S. ENVIRONMENTAL PROTECTION AGENCY:**

**Method 3050** Acid Digestion of Sediments, Sludges and Soils

**3.8 AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS:**

Industrial Ventilation Manual of Recommended Practices

**3.9 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI):**

**ANSI/ASC Z9.4** Exhaust Systems - Abrasive Blasting Operations - Ventilation and Safe Practice

## 4. Procedures

**4.1 SELECTING METHODS OF SURFACE PREPARATION AND DEBRIS COLLECTION**

**4.1.1 Surface Preparation Method:** Prior to selecting and specifying a containment system, it is necessary to determine the method to be used for surface preparation of the steel. Considerations for selecting surface preparation follow.

**4.1.1.1** Coatings can be removed from the surface by a variety of techniques. These include:

- Abrasive blasting (e.g. open blasting with expendable abrasives, open blasting with reusable abrasives, vacuum [closed] blasting with reusable abrasives, nonrecirculating closed blast systems).
- Water blasting and pressurized water jetting (with or without abrasives).
- Chemical stripping.
- Hand and power tool cleaning (with and without localized exhaust).

**4.1.1.2** Methods vary significantly in their productivity, degree of cleanliness and surface profile achieved, utility and support requirements, dust and waste produced, clean-up required, and costs. For example, open abrasive blasting with expendable abrasives requires the greatest quantity of abrasive and produces the greatest quantity of dust and debris. Methods which do not utilize abrasive generally produce the least amount of dust and debris.

Note: the toxicity characteristic of the waste is independent of the volume of the waste generated (e.g., paint chips alone or paint chips combined with abrasive). It should also be noted that the abrasive used for abrasive blast cleaning may contain toxic components.

**4.1.1.3** Before specifying a method of surface preparation, the manufacturer of the coating to be applied should be consulted to assure that the degree of cleaning and

Provided by : www.spic.ir Licensee: NISOC Library

surface profile produced will be satisfactory for coating system performance.

**4.1.2 Methods for Collecting Debris:** Debris may be collected from the surface at the point of cleaning (e.g., with vacuum) or from the general work area. The collection method should be selected in conjunction with the paint removal method and the containment system design to assure a completely integrated operation. The debris should be collected on a regular basis and not left to accumulate over the course of a job. Methods of collecting debris are described in Section 5.2.

### 4.2 SPECIFYING CONTAINMENT SYSTEMS

**4.2.1** The facility owner or representative should specify the class of containment required and/or the environmental monitoring criteria that will be used to verify its suitability. The specified containment must be maintained in accordance with the approved design throughout the course of surface preparation. Because of uncertainties in the measurement and significance of containment efficiencies, it is not a good practice to simply specify a level or percent of containment. Methods for specifying containment systems and items that must be considered are found in Sections 4.2.2, 4.2.3, and 4.2.4. Containment for paint application is outside of the scope of this Guide.

**4.2.2 Containment System Classes:** The classifications described below vary in the degree to which the containment design can be effective in controlling emissions of dust and debris into the environment. The degree of emissions control is greatest for Class 1 and least for Class 4. Selection of a containment system with greater emission control capability is required for surface preparation methods which produce the greatest quantity of dust and debris. Containments with lesser emissions control capability are required for surface preparation methods which produce the least quantity of dust and debris. For example, a Class 1 containment for abrasive blast cleaning (designated 1A) involves the use of more elaborate containment components than Class 1 for power tool cleaning (designated 1P). For this reason, individual tables have been prepared to identify the containment components for each of the classes according to the type of removal method.

When vacuum shrouding is employed around the removal tool, controls equivalent to Class 1 may be achieved through the use of ground covers or free hanging tarpaulins.

**4.2.2.1 Class 1:** This system provides the highest level of emissions control.

For abrasive blast cleaning, Class 1A normally requires air impenetrable walls with rigid or flexible framing, fully sealed joints, airlock or resealable entryways, and negative air achieved by forced or natural air flow (verified by instrument or visual monitoring) and exhaust air filtration. [Note: Class 2 from the original 1992 Guide 6I(CON) was combined with Class 1 in 1994 and designated as Class 1A.]

For wet methods of preparation, Class 1W normally requires water impermeable walls and floors with rigid or flexible framing, fully sealed joints, resealable entryways, and negative air achieved by forced or natural air flow (verified visually) and exhaust air filtration.

For chemical stripping, Class 1C normally requires water impermeable and chemical resistant walls and floors with rigid or flexible framing, fully sealed joints and overlapping entryways, and forced or natural air flow with exhaust air filtration.

For hand or power tool cleaning, Class 1P normally requires air impenetrable walls with rigid or flexible framing, fully sealed joints, resealable entryways, and negative air achieved through forced or natural air flow (verified visually) and exhaust air filtration.

**4.2.2.2 Class 2:** This system provides a high level of emissions control.

For abrasive blast cleaning, Class 2A normally utilizes air impenetrable walls with rigid or flexible framing, fully sealed joints, partially sealed entryways, forced or natural air flow (verified visually) and exhaust air filtration. [Note: Class 3 in the original 1992 Guide 6I(CON) was redesignated as Class 2A in 1994.]

For wet methods of preparation, Class 2W normally requires water impermeable walls and floors, rigid or flexible framing, fully sealed joints, overlapping entryways, and natural air flow.

For chemical stripping, Class 2C normally requires water impermeable and chemical resistant walls and floors with rigid or flexible framing, fully sealed joints, overlapping entryways, and natural air flow.

For hand or power tool cleaning, Class 2P normally requires air penetrable or impenetrable walls, rigid or flexible framing, fully sealed joints, overlapping or open seam entryways, and natural air flow.

**4.2.2.3 Class 3:** This system provides a moderate level of emissions control.

For abrasive blast cleaning, Class 3A normally utilizes air penetrable walls with rigid or flexible framing, partially sealed joints and entryways and exhaust air filtration. [Note: Class 4 in the original 1992 Guide 6I(CON) was redesignated as Class 3A in 1994.]

For wet methods of preparation, Class 3W normally requires water impermeable walls and floors, minimal framing, partially sealed joints, open seam entryways, and natural air flow.

For chemical stripping, Class 3C normally requires water impermeable and chemical resistant walls and floors, minimal framing, partially sealed joints, open seam entryways and natural air flow.

Provided by : www.spic.ir Licensee: NISOC Library

For hand or power tool cleaning, Class 3P normally requires air penetrable walls, minimal framing, partially sealed joints, open seam entryways, and natural air flow.

**4.2.2.4 Class 4:** This system provides a minimal level of emissions control.

For abrasive blast cleaning, Class 4A normally utilizes air penetrable walls with flexible framing, open seams and entryways, and natural air flow. [Note: Class 5 in the original 1992 Guide 6I(CON) was redesignated as Class 4A in 1994.]

For wet methods of preparation, this class is not applicable.

For chemical stripping, this class is not applicable.

For hand or power tool cleaning, this class is not applicable.

**4.2.2.5 Containment Class Tables:** Tables A, W, C, and P list various containment and ventilation components which can be utilized to achieve these different classes. Table A is used for abrasive blast cleaning, Table W for water blasting/water jetting, Table C for chemical stripping, and Table P for hand or power tool cleaning. The components are described in Sections 5.3 and 5.4. Note that other combinations of containment and ventilation components may provide dust and debris control similar to those suggested in the tables.

**4.2.3 Other Considerations in Specifying and Selecting Containment Systems:**

a. Type of structure (simple flat plate or beams versus complex trusses and joists).
b. Load bearing capacity and integrity of the containment system and of the structure. Note: Containment systems may need to be reviewed by a registered professional engineer prior to erection and use to confirm the structural adequacy of the containment and the effect of various loads imposed.
c. Size and elevation of structure (e.g., elevated water tank, small secondary bridge, etc.)
d. Location of structure (e.g., rural, urban, over water, etc.)
e. Proximity to other buildings, structures, operating equipment, and traffic. Tight confines may not permit the construction of certain containment devices.
f. Local climate (e.g., heavy winds, rain, snow, etc.)
g. Permitting. The construction of containment devices may be regulated by codes.
h. Construction of structure such as riveted or welded. On certain structures, the welding of containment system brackets adjacent to riveted seams should be avoided.
i. Additional work to be performed inside containment (e.g., the control of paint overspray).

## 4.3 SELECTING METHODS FOR ASSESSING THE QUANTITY OF EMISSIONS

**4.3.1** The specifier should select one or more of the following methods for monitoring the amount of dust or debris that escapes the work area.

Method A: Visible Emissions
Method B: Ambient Air Monitoring for PM-10
Method C: Occupational Monitoring of Area Emissions of Lead
Method D: Ambient Air Monitoring for Toxic Metals (TSP Lead)
Method E: Soil Analysis for Toxic Metals
Method F: Water and Sediment Analysis for Toxic Metals

These methods are described in Section 5.5. A method for assessing the efficiency of debris collection and bulk abrasive recovery is also addressed (see Section 5.6).

**4.3.2** If one or more of the methods is specified, the specification should identify the method selected, the frequency and duration of the tests that will be employed, the location of the monitors (in the case of instrument monitoring), and the acceptance criteria.

## 4.4 IMPLEMENTING CONTAINMENT PROJECT

**4.4.1 Preparation of Written Specification:** The specifier should incorporate the information derived in 4.1 through 4.3 in a written document that clearly defines what is required of the contractor, what is to be furnished by the owner, and how the work will be evaluated. It is also recommended that the specifier identify applicable regulations, codes, ordinances, etc., and the associated enforcement agencies. In addition, the document should include names of key contacts and provisions for resolving disputes.

**4.4.2 Implementation of Containment and Monitoring:** The owner should assure that the work is monitored as described above (see also Sections 9 and 10 of SSPC-PA Guide 5). A high level of involvement by the owner either directly or through knowledgeable designates should be maintained throughout the course of the project. Because of the newness of much of this technology, there is often a need to modify the specific terms of the specification, such as the paint removal methods employed, the design and construction of the containment, and the methods for monitoring the emissions.

**4.4.3 Project Documentation:** It is vital that the facility owner be provided with accurate and complete records of all the documents and activities including specifications, inspection and work reports, change orders,

Provided by : www.spic.ir Licensee: NISOC Library

weather conditions, various mitigating factors, contractor suppliers, activities by regulatory agencies in monitoring or guiding the work, disposal records and test results and data derived from containment, ventilation, air, soil, and other monitoring. These records and data are invaluable in evaluating the quality of the work and in determining conformance with the specifications. In addition, they can be added to the database being developed by the protective coatings industry on the most cost-effective and efficient means of debris containment.

**4.4.4 Disposal of Debris:** Surface preparation debris (e.g., spent abrasives and containment materials that cannot be reused), must be disposed of in accordance with Federal and state regulations on solid and hazardous waste. For more information, see SSPC-Guide 7.

**4.4.5 Cleaning of Reusable Equipment and Materials:** Loose surface lead dust shall be removed from equipment, containment materials, and other reusable items prior to transportation off-site.

## 5. Descriptions of Methods and Systems

**5.1 METHODS OF COATING REMOVAL:** The following is a list of methods that can be used successfully to remove coatings and to collect the debris. Mists, dusts, and debris created may or may not contain toxic metals. All waste discharges should be tested for toxic metals. The list is not considered to be all inclusive, as new and innovative methods are continually being developed.

**5.1.1 Hand Tool Cleaning:** Includes chipping hammers, scrapers, wire brushes, and sandpaper.

**5.1.2 Power Tool Cleaning:** Includes power operated wire brushes, sanders, scrapers, grinders, descalers, needle guns, and rotary peening equipment.

**5.1.3 Power Tool Cleaning with Localized Exhaust:** Includes power tools which contain integral vacuum-equipped shrouding. A brush or rubber sleeve on the shrouding conforms to the surface to enhance the control of dust and debris collection.

**5.1.4 Water Jetting Without Abrasive:** Includes all types of pressurized water jetting systems. The action of the water with or without cleaning solutions or rust inhibitors provides the cleaning. Pressures are as stated by the manufacturer of the equipment. Note that when removing hazardous paints, high pressures and certain cleaning solutions may cause the hazardous substances to be carried with the water. This water must be recycled or collected and disposed of properly. Water jetting at pressures from 10,000 to 25,000 psi is often called high pressure water jetting, and, at pressures over 25,000 psi, ultra high pressure water jetting.

**5.1.5 Water Jetting With Abrasive:** Includes pressurized water jetting systems with abrasive injection. Variations may mix abrasive and water in a separate tank or at the nozzle, or inject abrasive into the water stream. Pressures required as stated by the manufacturer of the equipment. Note that when removing hazardous paints, high pressures and certain cleaning solutions or rust inhibitors may cause the hazardous substances to be carried with the water. This water must be recycled or collected and disposed of properly. Water jetting at pressures from 10,000 to 25,000 psi is often called high pressure water jetting, and, at pressures over 25,000 psi, ultra high pressure water jetting.

**5.1.6 Wet Abrasive Blast Cleaning:** Includes compressed air blasting systems that incorporate water into the blast stream. Variations may mix abrasive and water in a separate tank or at the nozzle, or apply the water to the abrasive as it exits the nozzle. Pressures are required as stated by the manufacturer of the equipment. Note that when removing hazardous paints, high pressures and certain cleaning solutions or rust inhibitors may cause the hazardous substances to be carried with the water. This water must be collected and disposed of properly.

**5.1.7 Open Abrasive Blast Cleaning with Expendable Abrasives:** Blast cleaning using compressed air to propel abrasives through nozzles. The spent abrasives, paint, debris, trash, etc. are collected for disposal. Expendable abrasives are those which are not normally reused after the initial blast. For the purposes of this guide, expendable abrasives include natural minerals (e.g., quartz sand, flint, garnet, staurolite, olivine, etc.), and mineral slags formed in electric power generation or in smelting metals such as copper or nickel. Manufactured abrasives, such as aluminum oxide, and vegetable abrasives (e.g., walnut shell, corn cob, etc.) might also be included. Caution: Some expendable abrasives may contain heavy metals.

**5.1.8 Open Abrasive Blast Cleaning with Reusable Abrasives:** Blast cleaning using compressed air to propel abrasives through nozzles, except that the abrasives are collected, cleaned of paint and debris, and reused. Cast steel, malleable iron, chilled cast iron, garnet, and aluminum oxide abrasives are typically used. An abrasive's ability to be re-used depends on its type, durability, and hardness. (For more information, see SSPC-AB 2.)The abrasive reclaimer (collection and cleaning equipment) may be an integral part of the blast machine or it may be housed in a separate machine. Blasting and abrasive reclamation may operate simultaneously or independently.

Provided by : www.spic.ir Licensee: NISOC Library

The use of re-usable abrasives may reduce the volume of waste by a factor of 50 or more compared to expendable abrasives.

**5.1.9 Closed Abrasive Blast Cleaning with Re-Usable Abrasives:** Blast cleaning using compressed air or centrifugal wheels within a vacuum assembly to propel abrasives toward a surface and simultaneously remove the abrasive and debris. Once the collected abrasives are cleaned of paint and debris, they are reused. Reusable abrasives may reduce the volume of waste by a factor of 50 or more compared to expendable abrasives. Systems can be recirculating or non-recirculating.

**5.1.9.1 Vacuum Blasting:** Blast cleaning using compressed air to propel abrasives toward a surface. A special vacuum assembly equipped with a brush or rubber sleeve surrounds the blast nozzle, sealing it to the surface. The seal must be maintained between the assembly and the surface to create a completely closed blasting cycle. The abrasive is recirculated automatically, cleaned of paint and debris, and returned for reuse. Cast steel, malleable iron, chilled cast iron, and aluminum oxide abrasives are typically used.

**5.1.9.2 Wheel Blast Cleaning:** Blast cleaning wheel assemblies that propel abrasive to the surface using centrifugal force. A special vacuum assembly with a mask that seals the centrifugal wheel assembly to the surface is required. The seal must be maintained between the assembly and the surface to create a completely closed blasting cycle. The abrasive is recirculated automatically, cleaned of paint and debris, and returned for reuse. Cast steel, malleable iron, or chilled cast iron abrasives are typically used.

**5.1.9.3 Mechanical Non-Recirculating Blast System:** Equipment that shrouds the blast nozzle to contain and remove the debris. The abrasive may or may not be reused. If it is reused, cleaning the debris from the abrasive is accomplished as a separate operation.

**5.1.10 Chemical Stripping:** Use of chemical stripping solutions or slurries applied to the paint surface. Effectiveness of the chemicals may be enhanced by applying a cover such as cloth or paper to the surface after application to prevent evaporation. The softened paint is removed by peeling the cover or by hand scraping. Washing, flushing, and neutralization of the surface may be required, as well as collection of the rinsings for proper disposal. Note: Chemical stripping solutions themselves can be hazardous and may require special handling and disposal.

**5.2 METHODS OF COLLECTING DEBRIS:** Methods of collection include, but are not limited to, the following:

**5.2.1 Localized Collection at Point of Cleaning:** This method involves surrounding the coating removal equipment with a localized containment enclosure equipped with a vacuum (i.e. localized exhaust) to permit the collection of the debris as it is being generated. The localized containment or chamber must conform to the surface (e.g., to irregularities such as welds, angles, and appurtenances as well as flat surfaces) through the use of masks, brushes, or other suitable means that will minimize the escape of abrasive, dust, paint, or debris. This method may be more effective in controlling emissions when used on large open structures such as tank shells as compared with complex structures such as joists or trusses. The vacuum machine may be an integral part of the coating removal equipment or abrasive reclaimer, or may be a separate machine, but coating removal and vacuuming must be accomplished simultaneously.

**5.2.2 General Area Collection:** This method of collection involves the removal of spent abrasive and paint debris from a containment structure that encloses the work area, workers, and tools, rather than only enclosing the removal tool itself. Collection methods include, but are not limited to:

**5.2.2.1 Bulk Collection:** Collection of debris from ground covers, floor, deck, or structure components, either during or after surface preparation. Collection may include the use of brooms, magnetic brooms, brushes, shovels, wheelbarrows, buckets, bucket loaders, vacuums, vacuum trucks, conveyors, or other suitable means. Note that in the case of hazardous paint removal, OSHA regulations place restrictions on the use of some of these methods.

**5.2.2.2 Channeling:** Controlling the flow of debris in the direction of a central removal location is accomplished by the use of tarps, rigid panels, augers, funnels, or other suitable materials. The materials must be selected with consideration of the nature of the debris being channelled (e.g. water, chemical stripper, dry particulate, etc.). At the removal location, further collection may be accomplished using mechanical conveyors, vacuums, or other means. The channelling materials and equipment may be a part of, or independent of, the containment structure.

**5.3 CONTAINMENT ENCLOSURE COMPONENTS:** The components of containment enclosures are identified below. Consideration should be given to the use of flame retardant materials when applicable. Tables A, W, C, and P provide guidance on combining each of the components to design a containment system.

**5.3.1 Containment Materials**

**5.3.1.1 Type A1 - Rigid:** Containment materials consist of singular panels, interlocking panels, or modular

Provided by : www.spic.ir Licensee: NISOC Library

fabrications constructed of plywood, aluminum, rigid metal, plastic, or similar materials.

**5.3.1.2 Type A2 - Flexible:** Containment materials are comprised of screens, tarps, drapes, plastic sheeting, or similar materials.

**5.3.2 Penetrability of Containment Materials**

**5.3.2.1 Type B1 - Air Impenetrable:** Materials that are impervious to dust or wind, including, but not limited to:

- **Tarps or Drapes:** Formed or coated woven material free of holes or openings.
- **Plastic Sheeting:** Single or double ply, heavy wall construction plastic. Reinforced plastic may be necessary for some applications.
- **Panels:** Panels of plywood, aluminum, corrugated plastic, metal, or similar rigid materials. Note: Openings in materials reduce recovery efficiencies.

**5.3.2.2 Type B2 - Air Penetrable:** Material that is formed or woven to allow air flow but that can retain some airborne particles. Note: The design wind loads of air penetrable materials such as screens are the same as air impenetrable materials such as tarps. Openings in materials reduce recovery efficiencies.

**5.3.2.3 Type B3 - Water Impermeable:** Material that is impermeable to water.

**5.3.2.4 Type B4 - Chemical Resistant:** Material that is resistant to chemical stripping solutions and impermeable to the water used for rinsing.

**5.3.3 Support Structure**

**5.3.3.1 Type C1 - Rigid Support Structures:** These structures allow no movement and are comprised of scaffolding and framing to which the containment materials are affixed.

**5.3.3.2 Type C2 - Flexible Support Structures:** These structures allow minor movement and are comprised of cables, chains, or similar systems to which the containment materials are affixed.

**5.3.3.3 Type C3 - Minimal Support Structures:** These structures involve little to no supporting structure beyond cables or chains required to affix the containment materials to the structure itself and perhaps to the floor or ground.

**5.3.4 Treatment of Joints**

**5.3.4.1 Type D1 - Fully Sealed Joints:** All mating joints between the containment materials and the structure and floor or ground are sealed. Sealing includes overlapping of seams when using flexible materials and the use of stitching, taping, caulking, or other sealing measures. Consideration should be given to the chemical or water resistance of the sealing materials as appropriate.

**5.3.4.2 Type D2 - Partially Sealed Joints:** The containment materials are mated together. The use of overlapping seams is recommended, but complete sealing of all joints is not required.

**5.3.5 Entryways**

**5.3.5.1 Type E1 - Entryway Through Airlocks with Resealable Doors:** This entry system includes access doors that are capable of being repeatedly resealed. Air locks are used in addition, in order to minimize air exchanges and air losses through the entryways.

**5.3.5.2 Type E2 - Entryway Through Resealable Doors:** The use of doorways that are capable of being repeatedly resealed.

**5.3.5.3 Type E3 - Entryway Through Overlapping Door Tarps:** The use of multiple flap overlapping door tarps to minimize dust escape through the entryway.

**5.3.5.4 Type E4 - Entryway Through Open Seams:** Special doors are not employed. Entry into the work area is made through unsealed seams in the containment materials.

**5.4 VENTILATION SYSTEM COMPONENTS:** Items to be considered when assessing the requirements of ventilation systems are addressed below. Tables A, W, P, and C provide guidance on combining the containment and ventilation requirements. Note that when designing a ventilation system, it is necessary to balance the static pressure with the input air flow to avoid collapsing ductwork or the containment due to high negative pressures. Additional information on ventilation and exhaust design is found in References 3.8 and 3.9.

Note: The selection of the ventilation system from the information in this guide is to assist in the control of emissions released through the atmosphere, but does not assure worker safety. Representative air sampling in the worker's breathing zone for air contaminants should always be conducted when employees may be exposed in excess of the specified OSHA limits, and depending upon the results, changes to the ventilation system may be necessary. Air sample collection and analysis methods must conform to OSHA standards and NIOSH methods.

**5.4.1 Air Supply (Intake) Points**

Provided by : www.spic.ir Licensee: NISOC Library

**5.4.1.1 Type F1 - Controlled Air Supply (Intake):** The use of baffles, louvers, flap seals, filters, and ducts on supply air points to preclude inadvertent escape of abrasive and debris. They may or may not be used in combination with fans (see 5.4.2.1).

**5.4.1.2 Type F2 - Open Air Supply (Intake):** Open air entry points without the use of ducts, valves, or baffles.

**5.4.2 Input Air Flow**

**5.4.2.1 Type G1 - Forced Input Air Flow:** Fans or blowers are used at the supply air points or other locations within containment to assist air flow through the containment structure. When used with a negative pressure system, the input air flow must be properly balanced with the exhaust capacity throughout the range of operations.

**5.4.2.2 Type G2 - Natural Input Air Flow:** Fans or blowers are not used at supply air entry points.

**5.4.3 Air Pressure Inside Containment**

**5.4.3.1 Type H1 - Instrument Verification:** An average negative pressure throughout the enclosure of at least 0.03"(0.08 cm) water column (W.C.) relative to ambient conditions shall be maintained during the surface preparation and clean-up operations. Manometers or magnehelic gages can be used to verify negative pressure.

**5.4.3.2 Type H2 - Visual Verification:** Negative pressure shall be employed as verified through the concave nature of the wall, ceiling, or floor materials while taking into account wind effects. Smoke or other visible means inside or outside the containment can be used to observe air flow patterns.

**5.4.3.3 Type H3 - Not Required:** Specified degree of negative pressure not required.

**5.4.4 Air Movement Inside Containment:** Air movement is utilized inside containment for several reasons:

- to reduce the exposure of workers to airborne dust (e.g., in 29 CFR 1926.62, OSHA stipulates that engineering controls must be instituted to the extent feasible to control worker exposure to lead dust)
- to improve visibility
- to remove dust laden air
- to aid in preventing contaminants from escaping into the environment (e.g., in 40 CFR 260-268 EPA stipulates that no hazardous debris is permitted to be deposited on the ground, but no specific criteria have been established to achieve these goals)

**5.4.4.1 Type I1 - Minimum Air Movement is Specified:** Achieving air movement through the containment requires the use of mechanical ventilation (see Note 7.1). Air movement may be specified by several methods, such as the following:

- Establishing a minimum velocity of air (fpm) in crossdraft or down draft (see Note 7.2)
- Establishing a minimum volume of air (cfm) to ventilate a given volume of containment

The selection of methods and criteria for specifying or producing air movement should be based on an analysis of project-specific conditions, including the blasting pressure, number and size of blast nozzles, type, size and friability of abrasive, flow rate of abrasive, the lead or toxic metal content, thickness and age of the paint being removed, the type and size of structure being prepared, and the configuration of the containment system being installed.

While there are generally accepted criteria for specifying air movement, air velocity past the worker is often a primary consideration when designing ventilation systems, because of worker protection issues.

**5.4.4.2 Type I2 - Minimum Air Movement is Not Specified:** Under this approach, the specifier does not establish any criteria for minimum air movement in containment. Note that when removing lead containing paints, it may still be necessary to utilize feasible engineering controls to reduce airborne lead exposure in accordance with the provisions of 29 CFR 1926.62 and to prevent the escape of airborne lead particulates from the containment.

**5.4.5 Exhaust Air Flow/Dust Collection**

**5.4.5.1 Type J1 - Air Filtration Required:** Forced exhaust air flow into dust collectors (wet or dry) or bag houses sized appropriately for the type and size of particulate matter and for the volume and velocity of air moved through the containment.

**5.4.5.2 Type J2 - Air Filtration Not Required:** Natural exhaust air flow is employed without the use of forced air or dust filtration. Little control over the debris being emitted into the environment is possible when using dust producing methods of preparation such as abrasive blasting.

**5.5 METHODS FOR ASSESSING QUANTITY OF EMISSIONS:** Surface preparation and paint removal operations produce dust and debris which may be emitted into the environment. Methods for quantifying the amount of dust and debris escaping the work area are described below. Method A provides immediate feedback on the emissions created. Methods B, C, and D require days to receive results. Methods E and F provide results upon

Provided by : www.spic.ir Licensee: NISOC Library

project completion. Users must contact the appropriate state and local authorities to ascertain which of the methods are accepted for monitoring emissions, and to establish the appropriate acceptance criteria.

Note: Testing for PM-10 or monitoring of visible emissions may be of limited applicability or relevance to a hazardous paint removal project. Monitoring for the toxic metal (e.g., lead as in 5.5.4) may provide more useful and meaningful data.

**5.5.1 Method A - Visible Emissions:** Observations of visible emissions from the work area provide immediate feedback on the performance of the containment system. Two methods can be used:

**5.5.1.1 General Surveillance:** Visible emissions are permitted at given frequencies or durations provided they do not extend beyond an established boundary line (e.g., property line). Possible frequencies include:

- Level 0 Emissions - No visible emissions. Note: This level is typically not achievable during abrasive blasting.
- Level 1 Emissions - Random emissions of a cumulative duration of no more than 1% of the work day (e.g., five minutes in an eight hour work day).
- Level 2 Emissions - Random emissions of a cumulative duration of no more than 5% of the work day (e.g., 24 minutes in an eight hour work day).
- Level 3 Emissions - Random emissions of a cumulative duration of no more than 10% of the work day (e.g., 48 minutes in an eight hour work day).
- Level 4 Emissions - Emissions are unrestricted and may occur at any time.

Note: The workday activities for timing emissions encompass surface preparation and clean-up only.

**5.5.1.2 Opacity Scale:** Opacity measurements are made by trained, certified observers. A scale from 0% to 100%, in 5% increments, is used. Measurements are typically made at 15 second intervals for given periods of time (e.g., 30 minutes). The acceptance criteria must be established by the specifier. For example, a criteria might restrict the opacity to no more than 20% for any three minute period in 60 minutes. Local regulations may provide guidance as to the level of opacity that should be required.

**5.5.2 Method B - Ambient Air Monitoring for PM-10:** High volume air samplers equipped with PM-10 heads are used to assess the total amount of particulate matter 10 micrometers (0.39 mils) or less in size that escape the contained work area. The number of monitors to be used is based on wind direction and proximity to homes, playgrounds, businesses, bodies of water, etc. The National Ambient Air Quality Standard for PM-10 according to 40 CFR Part 50 is 150 $\mu g/m^3$ over a 24 hour period. 450 $\mu g/m^3$ over an eight hour period may provide a rational method for applying the EPA criteria, provided no emissions occur from the worksite during the remaining 16 hours. Monitoring should be conducted for a few days prior to beginning the work (for 8 hours to 24 hours per day, as appropriate) in order to establish background levels. Depending upon the variability of the results, full-time background monitoring throughout the project may be necessary.

**5.5.3 Method C - Occupational Monitoring of Area Emissions for Lead:** When lead paint is being removed, air quality measurements for lead can be determined in accordance with NIOSH Method 7082 using personal monitors outside of areas or equipment that may potentially emit lead. Action Level lead limits are 30 $\mu g/m^3$ (0.03 $mg/m^3$) per OSHA General Industry Standard 29 CFR 1910.1025 and OSHA Construction Industry Standard 29 CFR 1926.62. The perimeter of the work area should be isolated using signs, barriers, and ribbons in all locations where the Action Level is exceeded. Areas and equipment that should be monitored and isolated include, but are not limited to, the containment, dust collector, and abrasive recycling equipment.

**5.5.4 Method D - EPA Ambient Air Monitoring for Toxic Metals:** When removing paints containing toxic metals, air quality measurements for the toxic metals can be made by instrument monitoring in accordance with EPA criteria. The selection of monitoring locations should be based on factors including wind direction, surface or terrain irregularities, and proximity to homes, playgrounds, businesses, bodies of water, etc. Depending upon the variability of the results, full-time background monitoring throughout the project may be necessary.

High volume air samplers equipped for the collection of total suspended particulate (TSP) are used. When removing paints containing lead, the filters are analyzed for lead in accordance with the EPA 40 CFR Part 50, Appendix G. The National Ambient Air Quality Standard for Lead according to 40 CFR Part 50 is 1.5 $\mu g/m^3$ as a 90 day average.

Note: Since paint removal operations are not normally conducted continuously over a 90 day period, it may be necessary to establish a daily criteria for monitoring. Note that the suggested modification of the procedure shown below may not be acceptable to state or local environment officials. The appropriate officials should be contacted prior to its implementation.

$$\mathbf{DA = (90 \div PD) \times 1.5\ \mu g/m^3}$$

DA = Daily Allowance ($\mu g/m^3$)
PD = Number of preparation days anticipated in a 90-day period

The above calculation provides an allowance criteria for a 24 hour period. In order to convert this value to an

Provided by : www.spic.ir Licensee: NISOC Library

allowance corresponding to the hours worked, do the following:

**ADA = DA (24 ÷ H)**

ADA = Adjusted Daily Allowance (μg/m³)
DA = Daily Allowance (μg/m³)
H = Hours worked in 24 hours

**5.5.5 Method E - Soil Analysis for Toxic Metals:** A pre-job and post-job soil analysis for toxic metals (e.g. lead) is useful for determining if adequate ground protection was employed.

Prior to project start-up, select test sites beneath the structure if applicable and a minimum of one to two from 10 to 100 feet (3 to 30 m) away from the structure in each of four directions. Long structures such as bridges may require additional sampling locations. Document the specific location of each site. At each test site, center and align a 1 sq. ft. (30.5 cm²) template parallel or tangential to the structure. Remove a sample of soil 3/4 in. (1.9 cm) in diameter and 1/2 in. (1.3 cm) in depth at the center of the square and at each of the four corners. Combine the five soil plugs in a single bag to represent the sample at the given location. At project completion, return to the same locations and remove a similar sample. Analyze the pre-job and post-job soil samples for the appropriate toxic metals in accordance with EPA Method 3050. The specifier must establish the increase allowable, if any.

Note: It must be recognized that the preexisting levels of toxic metals in the soil (e.g., lead) can vary considerably from one location to the next (even within one or two feet) due to prior land use, past paint removal projects, previous paint spills, leaded gasoline, and other factors. This must be taken into consideration when specifying the use of soils tests and when interpreting the results.

**5.5.6 Method F - Water and Sediment Analysis for Toxic Metals:** Pre-job and post-job assessment of toxic metals (e.g., lead) in sediment can be useful in determining if proper protection of a water body has been achieved. Pre-job sampling should be accomplished in discrete locations around and beneath the project site to a sediment depth of no more than 6 in (15.6 cm). Samples should be removed at the same locations upon project completion.

Sampling of water may or may not provide valuable information due to the transient nature of the toxic metal (e.g. lead) in fast moving water bodies (sediment analysis may be a more reliable indicator). However, for sedentary bodies of water or if a drinking water intake is located nearby, pre-job and post-job water sampling and analysis may be beneficial.

**5.6 METHOD OF ASSESSING EFFICIENCY OF DEBRIS COLLECTION AND BULK ABRASIVE RECOVERY**

**5.6.1 Weigh In/Weigh Out Method:** This method is suitable for estimating the efficiency of debris collection and bulk abrasive recovery. It is not suitable for estimating air emissions.

Determine the dry weight of abrasive (Wa) used in blast cleaning an entire structure or portions of a structure and the weight of paint debris (Wp) for the same area. Determine the dry weight of abrasive and paint debris removed from blast cleaning the entire structure or portions of structure (Wd). Compute the recovery efficiency (RE) as follows:

$$RE = \frac{W_a}{W_P + W_d} \times 100$$

## 6. Disclaimer

While every precaution is taken to ensure that all information furnished in SSPC guides, standards, and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials or methods specified therein, or of the guide itself.

## 7. Notes*

**7.1** In the preamble to 29 CFR 1926.62, OSHA states (pg 26614) that it believes an exposure reduction factor of 50% will be achievable for mechanical ventilation systems. If feasible engineering controls do not reduce the exposure below the PEL, administrative controls, good work practices, and effective use of respiratory protective equipment are needed in addition to feasible engineering controls to help control worker exposures to lead and other toxic metals.

**7.2** The OSHA Interim Final Rule on Lead in Construction (29 CFR 1926.62) does not specify air velocities moving through containment, but it states that engineering and work practice controls must be utilized as necessary to reduce airborne exposures.

**7.3** The construction industry ventilation standard (29 CFR 1926.57) refers to ANSI Z9.2-1979 with regard to abrasive blast cleaning. ANSI Z9.2-1979 in Table A2 suggests a downdraft velocity in abrasive blasting rooms of 60 to 100 feet per minute. Another ANSI reference regarding ventilation in abrasive blasting rooms is ANSI Z9.4-1985, which suggests provision of a downdraft ranging from 60 to 90 feet per minute (the larger the floor area, the lower the air flow recommendation), or a cross draft of 100 feet per minute when removing coatings containing toxic metals by dry abrasive blasting.

SSPC recognizes that fixed abrasive blast rooms are not the same as field containment structures, and is making no representations regarding the suitability of the velocities (whether too much or too little). For example, Federal Highway Administration research involving air movement inside containment when removing lead paint by abrasive

Provided by : www.spic.ir Licensee: NISOC Library

blast cleaning (research Report Number RD-94-100) found no significant differences in worker lead exposures at cross-draft velocities of 70 to 300 feet per minute. (The abrasives involved in the study were steel grit and mineral sand.) The blast room information is presented in these Notes due to the link to ANSI Z9.2 that is provided through 29 CFR 1926.57, and because it may provide information that could be beneficial to some users of the Guide.

**7.4** ANSI Z9.2-1979 indicates that large solid particles usually cannot be captured by conventional air flow patterns, but that air flow patterns should ensure that hygienically significant particle sizes are captured. Hygienically significant particle sizes are defined as those which are less than 10 micrometers in size. It suggests that the larger particle sizes should be allowed to fall to the floor to be removed by housekeeping practices. As a result, when designing ventilation systems for containment, primary consideration should be given to the movement of the hygienically significant particle sizes through the enclosure to the exhaust hood in combination with good housekeeping practices to remove the heavier particles.

**7.5** ANSI Z9.2-1979 states in paragraph 4.8.1(1) that if data on control velocity and volume are not available in reliable published information, control velocity and volume can be determined by measurement of actual air-flow velocities for projects on which control has been attained. Little information has been published regarding control velocities in field containments. As a result, the specifier may consider allowing the contractor to demonstrate that the proposed air velocity inside containment will provide the necessary and desired controls (i.e., reduced worker exposures, controlled blood lead levels, controlled emissions and so forth) to comply with the OSHA mandate for engineering controls.

* Notes are not requirements of this guide.

Provided by : www.spic.ir Licensee: NISOC Library

## TABLE A - ABRASIVE BLAST CLEANING*
## COMBINATIONS OF CONTAINMENT AND VENTILATION SYSTEM COMPONENTS

| Containment Classification | Containment System (5.3 of SSPC-Guide 6) | | | | | Ventilation (5.4 of SSPC-Guide 6) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5.3.1 Containment Materials | 5.3.2 Penetrability | 5.3.3 Support Structure | 5.3.4 Joints | 5.3.5 Entryway | 5.4.1 Air Make-Up | 5.4.2 Input Air Flow | 5.4.3 Air Pressure | 5.4.4 Air Movement | 5.4.5 Exhaust Dust Filtration |
| Class 1A | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable | C1- Rigid<br>C2-Flexible | D1-Full Seal | E1-Airlock<br>E2-Resealable | F1-Controlled | G1-Forced | H-1 Instrument Verification | I1-Minimum Specified | J1-Air Filtration |
| Class 2A | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable | C1- Rigid<br>C2-Flexible | D1-Full Seal | E2-Resealable<br>E3-Overlap | F1-Controlled<br>F2-Open | G1-Forced<br>G2-Natural | H2-Visual Verification | I1-Minimum Specified | J1-Air Filtration |
| Class 3A | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable<br>B2-Air Penetrable | C1- Rigid<br>C2-Flexible | D1-Full Seal<br>D2-Partial Seal | E4-Open Seam | F1-Controlled<br>F2-Open | G1-Forced<br>G2-Natural | H3-Not Required | I2-Not Specified | J1-Air Filtration |
| Class 4A | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable<br>B2-Air Penetrable | C3-Minimal | D2-Partial Seal | E4-Open Seam | F2-Open | G2-Natural | H3-Not Required | I2-Not Specified | J2-No Controls on Exhaust |

Note 1: The information in this table is provided for guidance only and does not guarantee that any specific levels of containment will be achieved by following the suggestions. The type of structure, wind conditions, soundness of the materials of construction, and many other factors play a role in containing dust and debris.

Note 2: The table occasionally identifies two options for a given component. For example, containment materials (5.3.1) are shown as being either rigid or flexible. If the specifier requires the use of rigid materials only, this restriction must be specified separately.

Note 3: The design suggestions made in this table are based on the use of open abrasive blast cleaning inside containment. The classifications are ordered from the greatest degree of dust and debris containment (Class 1A). Normally, the higher the degree of containment, the higher the costs.

Note 4: Many other combinations of the components beyond those suggested above can be used to provide similar results. The method of preparation can also be adjusted to reduce or eliminate dust emissions.

Note 5: Certain combinations of components within each class may not be suitable when removing hazardous paints (e.g., forced air input in combination with penetrable containment materials in Class 3A).

Note 6: When designing a ventilation system, care must be taken to balance the static pressure with the input air flow to avoid collapsing the containment due to high negative pressure.

* When vacuum shrouded blast cleaning is employed, ground covers or free-hanging tarpaulins may provide controls equivalent to Class 1A.



Provided by : www.spic.ir Licensee: NISOC Library

## TABLE W - WATER BLASTING/WATER JETTING*
## COMBINATIONS OF CONTAINMENT AND VENTILATIONS YSTEM COMPONENTS

| Containment Classification | Containment System (5.3 of SSPC-Guide 6) | | | | | Ventilation (5.4 of SSPC-Guide 6) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5.3.1 Containment Materials | 5.3.2 Penetrability | 5.3.3 Support Structure | 5.3.4 Joints | 5.3.5 Entryway | 5.4.1 Air Make-Up | 5.4.2 Input Air Flow | 5.4.3 Air Pressure | 5.4.4 Air Movement | 5.4.5 Exhaust Dust Filtration |
| Class1W | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable<br>B3-Water Impermeable | C1-Rigid<br>C2-Flexible | D1-Full Seal | E2-Resealable | F2-Open | G1-Forced` | H2-Visual Verification | I1-Minimum Specified | J1-Filtration |
| Class 2W | A1-Rigid<br>A2-Flexible | B3-Water Impermeable | C1-Rigid<br>C2-Flexible | D1-Full Seal | E3-Overlap | F2-Open | G2-Natural | H3-Not Required | I2-Not Specified | J2-Not Required |
| Class 3W | A-1 Rigid<br>A-2 Flexible | B3-Water Impermeable | C3-Minimal | D2-Partial Seal | E4-Open | F2-Open | G2-Natural | H3-Not Required | I2-Not Specified | J3- Not Required |

Note 1: When designing a ventilation system, care must be taken to balance the static pressure with the input air flow to avoid collapsing the containment or ductwork due to high negative pressure.

Note 2: The table occasionally identifies two options for a given component. For example, containment materials (5.3.1) are shown as being either rigid or flexible. If the specifier requires the use of rigid materials only, this restriction must be specified separately.

* When vaccuum shrouded water jetting is employed, ground covers or free-hanging tarpaulins may provide controls equivalent to Class 1W.





Provided by : www.spic.ir Licensee: NISOC Library

## TABLE C - CHEMICAL STRIPPING
## COMBINATIONS OF CONTAINMENT AND VENTILATION SYSTEM COMPONENTS

| Containment Classification | Containment System (5.3 of Guide) | | | | | Ventilation (5.4 of Guide) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5.3.1 Containment Materials | 5.3.2 Penetrability | 5.3.3 Support Structure | 5.3.4 Joints | 5.3.5 Entryway | 5.4.1 Air Make-Up | 5.4.2 Input Air Flow | 5.4.3 Air Pressure | 5.4.4 Air Movement | 5.4.5 Exhaust Dust Filtration |
| Class 1C | A1-Rigid<br>A2-Flexible | B1-Air Impenetrable<br>B4-Chemical Resistant | C1-Rigid<br>C2-Flexible | D1-Full Seal | E3-Overlap | F2-Open | G1-Forced | H3-Not Required | I2- Not Specified | J1-Filtration |
| Class 2C | A1-Rigid<br>A2-Flexible | B4-Chemical Resistant | C1-Rigid<br>C2-Flexible | D1-Full Seal | E3-Overlap | F2-Open | G2-Natural | H3-Not Required | I2-Not Specified | J2-Not Required |
| Class 3C | A1-Rigid<br>A2-Flexible | B4-Chemical Resistant | C3-Minimal | D2-Partial Seal | E4-Open Seam | F2-Open | G2-Natural | H3-Not Required | I2-Not Specified | J2-Not Required |

Note 1: When designing a ventilation system, care must be taken to balance the static pressure with the input air flow to avoid collapsing the containment or ductwork due to high negative pressure.

Note 2: The table occasionally identifies two options for a given component. For example, containment materials (5.3.1) are shown as being either rigid or flexible. If the specifier requires the use of rigid materials only, this restriction must be specified separately.



Provided by : www.spic.ir Licensee: NISOC Library

## TABLE P - POWER TOOL CLEANING*
## COMBINATIONS OF CONTAINMENT AND VENTILATION SYSTEM COMPONENTS

| Containment Classification | Containment System (5.3 of SSPC-Guide 6) | | | | | Ventilation (5.4 of SSPC-Guide 6) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5.3.1 Containment Materials | 5.3.2 Penetrability | 5.3.3 Support Structure | 5.3.4 Joints | 5.3.5 Entryway | 5.4.1 Air Make-Up | 5.4.2 Input Air Flow | 5.4.3 Air Pressure | 5.4.4 Air Movement | 5.4.5 Exhaust Dust Filtration |
| Class 1P | A1-Rigid | B1-Air Impenetrable | C1-Rigid | D1-Full Seal | E2-Resealable | F1-Combined | G1-Forced | H2-Visual Verification | I1-Minimum Specified | J1-Filtration |
| | A2-Flexible | B2-Air Penetrable | C2-Flexible | | | | | | | |
| Class 2P | A1-Rigid | B1-Air Impenetrable | C1-Rigid | D1-Full Seal | E3-Overlap | F2-Open | G2-Natural | H3-Not Required | I2-Not Specified | J2-Not Required |
| | A2-Flexible | B2-Air Penetrable | C2-Flexible | | E4-Open Seam | | | | | |
| Class 3P | A1-Rigid | B1-Air Impenetrable | C3-Minimal | D2-Partial Seal | E4-Open Seam | F2-Open | G2-Natural | H3-Not Required | I2-Not Specified | J2-Not Required |
| | A2-Flexible | B2-Air Penetrable | | | | | | | | |

Note 1: When designing a ventilation system, care must be taken to balance the static pressure with the input air flow to avoid collapsing the containment or ductwork due to high negative pressure.

Note 2: The table occasionally identifies two options for a given component. For example, containment materials (5.3.1) are shown as being either rigid or flexible. If the specifier requires the use of rigid materials only, this restriction must be specified separately.

* For hand tool cleaning or vacuum shrouded power tool cleaning, ground covers or free-hanging tarpaulins may provide controls equivalent to Class 1P.





Provided by : www.spic.ir Licensee: NISOC Library

# SSPC: The Society for Protective Coatings

# GUIDE 7

## Guide for the Disposal of Lead-Contaminated Surface Preparation Debris

### 1. Scope

**1.1** This guide provides information regarding handling, testing, and disposal of solid debris generated during preparation of surfaces previously painted with lead-containing paint.

**1.2** This guide is based on federal regulations only. State or local regulations may be more restrictive and must be investigated. States or other local jurisdictions may have requirements which are stricter, such as requiring other analytical procedures or regulating other metals. Non-hazardous waste containing lead is also regulated in some states.

**1.3** This guide does not cover removal of the coating from the structure or containment of the debris. These activities are described in SSPC-Guide 6.

**1.**4 While this guide is written primarily with reference to removing lead-based paints, other elements as presented in Table 1 may also cause the debris to be classified as a hazardous waste.

**1.5** This guide does not cover disposal of water from methods of cleaning.

**1.6** Wastes not discussed in this guide should be handled in compliance with all applicable regulations.

**1.7** This guide is intended to be used by facility owners, specifiers, or contractors.

### 2. Description and Definitions

**2.1 GENERAL:** Surface preparation debris may include old paint, spent abrasives, corrosion products, dirt, dust, grease, and salts. Constituents such as lead, cadmium, chromium, or other heavy metals may result in the waste stream being classified as hazardous waste, requiring special handling and disposal. Special handling and disposal may also be required for non-hazardous wastes under certain circumstances. It is important to note that the surface preparation debris is not classified as hazardous waste until tested, although it must be regarded and handled as a hazardous material until shown to be non-hazardous.

**2.2 OUTLINE OF PROCEDURE:** The major activities covered in this guide are as follows:

**2.2.1 Site Procedures Prior to and Including Classifying Waste (Section 5):** These include collecting, packaging, transporting to a temporary storage area, as well as temporary storage, sampling, testing, and classifying waste.

**2.2.2 Procedures for Disposing of Hazardous Waste (Section 6):** The generator must obtain an EPA ID number and determine the disposal options. For disposing of waste offsite, the generator must select a TSD (treatment, storage, and disposal) site, select a waste hauler, prepare a manifest, ship the waste, and prepare a biennial report. For treatment of waste on-site, in accumulation containers, the generator must determine the time allowed for treatment, select a treatment method, prepare and submit a waste analysis plan, treat the waste, and verify that it is non-hazardous and can be disposed of at a non-hazardous site.

**2.2.3 Procedures for Disposing of Non-Hazardous Waste (Section 7):** The generator must identify any state or local requirements or restrictions, select a non-hazardous disposal facility, and ship the waste to the facility.

**2.2.4 Commentary (Section 8):** In addition, the guide provides an extensive commentary section discussing regulations, testing and sampling procedures, and other important considerations.

**2.3 DEFINITIONS**

**2.3.1 Chain of Custody Form:** A form used for tracking waste samples through transportation, receipt at the laboratory, and testing.

**2.3.2 D 008:** EPA Hazardous Waste Number for wastes containing lead.

**2.3.3 Discharge:** Accidental or intentional spilling, leaking, pumping, pouring, emitting, emptying, or dumping of hazardous waste into or on any land, water, or air.

**2.3.4 Disposal:** Discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters.

Provided by : www.spic.ir Licensee: NISOC Library

**2.3.5 EPA Identification Number:** The number assigned by the EPA to each generator, transporter, and treatment, storage, or disposal facility.

**2.3.6 Generator:** Any person, by site, whose act or process produces hazardous waste identified or listed in 40 CFR Part 261, or whose act first causes a hazardous waste to become subject to regulation. (This definition is exactly as it appears in 40 CFR Part 260.10. As this definition pertains to paint removal operations, the owner of the structure is classified as the generator. The contractor may be classified as a co-generator depending on local regulation, practice, or contractual agreement.)

**2.3.7 Landfill - Subtitle C:** A landfill permitted in accordance with Subtitle C of the Resource Conservation and Recovery Act for the disposal of hazardous waste.

**2.3.8 Landfill - Subtitle D:** A landfill permitted in accordance with Subtitle D of the Resource Conservation and Recovery Act for the disposal of non-hazardous waste.

**2.3.9 Manifest:** The shipping document U.S. EPA Form 870022 and, if necessary, U.S. EPA Form 8700-22A, originated and signed by the generator.

**2.3.10 Manifest Document Number:** The U.S. EPA twelve digit identification number assigned to the generator plus a unique five digit document number assigned to the manifest by the generator for recording and reporting purposes.

**2.3.11 On-Site:** The same or geographically contiguous property which may be divided by a public or private right-of-way, provided the entrance and exit between the properties is at a crossroads intersection, and access is by crossing as opposed to going along the right-of-way. Non-contiguous properties owned by the same person but connected by a right-of-way, which he controls and to which the public does not have access, is also considered on-site property.

**2.3.12 Representative Sample:** Sample of a universe or whole which can be expected to exhibit the average properties of the universe or whole.

**2.3.13 Storage:** Holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere.

**2.3.14 Treatment:** Any method, technique, or process designed to change the physical, chemical, or biological characteristics or composition of any hazardous waste so as to neutralize such waste, or so as to recover energy or material resources from the waste, or so as to render such waste non-hazardous or less hazardous; safer to transport, store or dispose of; or amenable for recovery, amenable for storage, or reduced in volume.

## 3. Reference Documents

**3.1** The standards and other reference documents referred to in this guide are listed in Sections 3.2 through 3.5 and form a part of this guide.

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

**3.3 SSPC STANDARDS:**

| | |
|---|---|
| **PA Guide 5** | Guide to Maintenance Painting Programs |
| **Guide 6** | Guide for Containing Debris Generated During Paint Removal Operations |

**3.4 CODE OF FEDERAL REGULATIONS:**

| | |
|---|---|
| **29 CFR 1910.1018** | Inorganic Arsenic (General Industry Standard) |
| **29 CFR 1910.1025** | Lead (General Industry Standard) |
| **29 CFR 1926.62** | Lead (Construction Industry Standard) |
| **29 CFR 1926.63** | Cadmium (Construction Industry Standard) |
| **40 CFR Part 260** | Hazardous Waste Management System: General |
| **40 CFR Part 261** | Identification and Listing of Hazardous Waste |
| **40 CFR Part 262** | Standards Applicable to Generator of Hazardous Waste |
| **40 CFR Part 263** | Standards Applicable to Transporters of Hazardous Waste |
| **40 CFR Part 264** | Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities |
| **40 CFR Part 265** | Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities |
| **40 CFR Part 268** | Land Disposal Restrictions |

**3.5. U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA):**

| | |
|---|---|
| **SW846** | Test Methods for Evaluating Solid Wastes |

Provided by : www.spic.ir Licensee: NISOC Library

## 4. Procedures Prior to Waste Collection

**4.1 PLANNING:** Surface preparation debris is a waste generated by the need to maintain structures by removing and replacing existing coatings. In planning maintenance painting, one must take into account the regulations, restrictions, quality of protection, and economics of the entire operation. Activities range from condition assessment, to selecting a maintenance option, to containment and disposal of waste. Considerations and procedures for planning maintenance painting programs are given in SSPC-PA Guide 5.

**4.2 FACTORS AFFECTING WASTE:** The quantity of the waste generated and the concentration of lead and other composition factors is affected by the method used to remove the existing coating. Abrasive blasting with non-recyclable abrasive produces the greatest volume of waste. Significantly less waste is generated using recyclable abrasives. Non-blast-cleaning methods such as power tool cleaning generate the least waste.

**4.3 REMOVING AND CONTAINING LEAD AND OTHER PAINT:** Methods for removing existing paint and preventing the paint from contaminating the environment are described in SSPC-Guide 6. This guide also describes methods for monitoring the effectiveness of containment.

## 5. Site Procedures Prior to and Including Classifying Waste

The following procedures are required by the waste generator prior to determining if the waste is hazardous. Although the surface preparation debris is not classified as hazardous waste until tested, it should be handled as a hazardous material until it is proven to be non-hazardous.

**5.1 COLLECT WASTE:** Proper collection of the surface preparation debris is one of the most important steps in handling the debris. Removing the debris from the work area into the storage containers must be carried out without releasing removed lead or other wastes into the environment. Precautions must be taken to prevent release of the removed lead-containing paint into the air, water, or soil. Collection of the potentially hazardous debris should be carried out frequently, typically at least once per day. When containing disposable abrasives, cleaning may be done less frequently as long as the debris is not permitted to escape from containment. Whether collection is carried out using mechanical devices or by hand tools, it is important that the workers be fully protected against breathing, ingesting, or contacting any of the debris. Requirements for protecting workers are covered in documents referenced in Section 3.4.

Care must be taken to not redisperse the material into the air, water, or soil during collection. Samples of material for analysis should be taken during collection, as described in Section 5.6.

**5.2 PACKAGE AND LABEL WASTE:** The lead-containing spent blast media or other debris must be stored in a manner which will not allow entry of any hazardous material into the environment. Leakproof drums or portable bins, such as gondolas, are generally acceptable. The lids of the drums, or the covers of the bins, must be firmly secured. The containers must be kept out of flood plains or areas where run-off may occur. Weather resistant labels using indelible ink warning of the potential hazards associated with the material must be placed on the containers. The containers should be marked with the contents, tare weights of the containers, and the origin and date of collection of the material. The containers must be keyed to the samples taken.

**5.3 TRANSPORT WASTE TO TEMPORARY STORAGE AREA:** The filled containers can then be moved to a temporary holding area at the work site. During the moving operations, normal precautions must be taken to prevent damage which would result in spillage of contents or entry of water into the containers. Transportation of hazardous waste from the job site to the temporary storage may be performed by the generator. No permit is needed for on-site hauling. Transportation directly to a temporary or permanent off-site storage area must be done in accordance with 40 CFR Part 263.

**5.4 STORE WASTE AT TEMPORARY SITE:** Site storage involves grouping of materials by particular work site, even though the physical location of the storage site may be separated from the work site itself. Regardless of the location of the storage site, certain requirements remain constant.

The site must be secure. Security begins with the choice of a suitable location. Storage sites must be on well-drained ground which is not subject to flooding (40 CFR Part 264.18). The area should be enclosed by a fence, and prominent warning signs should be displayed around the perimeter. If the same storage site is also used for equipment and supplies, the waste containers should be segregated within the site. This can be accomplished by placing all the debris material in an assigned area within the secured site and surrounding this area with a temporary "fence" of ribbons or thin rope. Identification and warning signs should be posted where the material is being stored, and all drums must be placed on pallets or dunnage to prevent corrosive attack from moist soil. The containers must be arranged so that the labels are visible at all times. The site must be adequately protected from vandalism or unauthorized access by the public (40 CFR Part 264.14).

Provided by : www.spic.ir Licensee: NISOC Library

### 5.5 ACCUMULATION TIME AND REQUIREMENTS

**5.5.1 Accumulation Time:** Hazardous waste can be accumulated on-site for purposes of collecting enough waste to make transportation more cost effective. The length of time hazardous waste can remain in on-site storage is primarily dependent upon the amount of waste generated.

**5.5.1.1** Large quantity generators produce 1,000 kg (2,200 lbs) per month. For large quantity generators, the accumulation period is a maximum of 90 days. A 30-day extension can be granted at the discretion of the Regional U.S. EPA Administrator on a month-to-month basis.

**5.5.1.2** A small quantity generator who produces greater than 100 kg (220 lbs) but less than 1,000 kg (2,200 lbs) per month may accumulate waste on-site for a maximum of 180 days. If the waste must be transported over 200 miles for treatment or disposal, the time is extended to 270 days. A 30-day extension can be granted by the Regional U.S. EPA Administrator on a case-by-case basis.

**5.5.1.3** Generators exceeding the accumulation time are considered to be the operators of hazardous waste storage facilities, and must comply with the regulations in 40 CFR Parts 264 and 265.

**5.5.2 Emergency Plan:** A contingency plan and procedures for use in an emergency must be developed. Large quantity generators must have a written contingency plan. Small quantity generators are not required to have the plan in writing.

**5.5.3 Personnel Training:** Workers involved in handling and storage of hazardous waste must successfully complete a program of classroom instruction or on-the-job training that teaches them to perform their duties in a manner consistent with the regulations and how to respond in emergencies (40 CFR Part 265.16). The employer must maintain records of training received by each employee. An annual review by employees is required.

**5.6 SAMPLING:** Sampling of debris for testing and analysis (see Section 5.7) is the responsibility of the generator (40 CFR Part 262.11). Information on sampling methods is given in 40 CFR Part 261, Appendix 1.

**5.6.1 Sampling Plan:** A sampling plan must be developed prior to beginning work. The sampling plan should include who will be responsible for the sampling, how often samples will be taken, how the samples will be obtained, where the samples will be taken, and how the samples will be handled.

**5.6.2 Representative Samples**

**5.6.2.1** It is necessary to obtain representative samples in order to obtain legitimate results. The proper method for spent abrasive is to use a random sampling technique. A representative sample of a day's work might consist of one shovelful from each wheelbarrow of spent abrasive. The spent abrasive is then mixed and quartered until it is reduced to one gallon.

**5.6.2.2** If one waits until the end of the job to lift samples, the task becomes very difficult, if not impossible. There are thieving devices available for such sampling, but a somewhat nonuniform material like spent abrasives would still be very difficult to sample.

**5.6.2.3** For small jobs, in which the surface preparation is completed in one month or less, the samples could be retained until the end of the job and then tested. For longer jobs, the samples should be tested when 25 percent of the surface preparation is completed, provided the 90-day accumulation period for large quantity generators is not exceeded. It is recommended that additional samples be retained from this final operation in case there are any questions later.

**5.6.3 Number of Samples:** The number of samples needed is determined by the variability of the laboratory test results. SW 846, Chapter 9 - Sampling Plan, presents the requirements for determining the number of samples. Appendix A presents a detailed discussion of sampling requirements and interpreting results.

**5.6.3.1 Minimum Number of Samples:** The minimum number of samples to be collected is four.

**5.6.4 Testing of Initial Sample:** The samples should be sent to the laboratory with instructions to analyze just one. Some states require a Chain of Custody Form to accompany the samples sent to the laboratory.

If the results are 10 mg/L or greater for leachable lead, the waste should be declared hazardous, and no further laboratory testing is needed. If 10 mg/L leachable lead is found in one sample, then 0 mg/L leachable lead must be found for the other three samples to achieve a leachable lead content of 6.3 mg/L for the waste these samples represent. The probability of this occurring is extremely low if these are representative samples.

If the result is between 5 and 10 mg/L, the generator must decide whether or not to measure the leachable lead content of the other three samples to determine if the waste is non-hazardous, or to forego further testing and declare the waste to be hazardous.

If the result of the initial test is less than 5 mg/L, the other three samples should be tested to determine the waste classification.

Provided by : www.spic.ir Licensee: NISOC Library

**5.6.5 Determine Need for Additional Samples**

- If the average results obtained from the initial four samples show the waste to be hazardous, no further samples need to be tested.
- If the average of the four samples plus the confidence interval (Appendix A) is 5 mg/L or less, the waste is classified as non-hazardous and no further samples are required.
- If the average of the four samples is less than 5 mg/l, but the confidence interval increases it to above 5 mg/L, additional samples may be needed to establish that the waste is non-hazardous. The appropriate number of samples can be calculated from Appendix A.

**5.7 TESTING AND ANALYSIS**

**5.7.1** Testing of the debris is performed by a laboratory. Some states or organizations have requirements regarding who can perform the laboratory analysis. The Federal government does not approve waste testing laboratories. Jurisdictions over laboratories approved to perform testing vary from state to state, or between different authorities within the state. The generator should use a laboratory which performs the analysis in accordance with test procedures and quality assurance requirements in 40 CFR Part 268, Appendix 1. This is EPA Method 1311, Toxicity Characteristic Leaching Procedure (TCLP).

**5.7.2** Method 1311 basically consists of putting the solid waste in an acetic acid solution and tumbling the slurry for a period of time (18 hours). The slurry is filtered and a sample of the liquid is then tested for the chemical elements of interest.

**5.7.3** Once the concentrations of the elements of interest have been obtained, the average (x), standard deviation (S), standard error (Sx), and confidence interval (C.I.) are calculated as shown in Appendix A.

**5.8 DETERMINING IF WASTE IS HAZARDOUS**

**5.8.1** If the waste tested as described in 5.7 has a leachable lead concentration of 5 mg/L or greater, the waste is considered hazardous. The threshold level of leachability for other heavy metals is shown in Table 1.

**5.8.2** In determining whether the waste is hazardous, one uses the average value of the leachable lead concentration of the four samples selected as in 5.6. Because of statistical fluctuations, the EPA requires that the average value plus the confidence interval, when computed as described in Appendix A, be less than 5 mg/L for lead. If the average is less than 5 but the confidence interval brings the total above 5 mg/L, the waste is considered hazardous. It may be possible to reduce the confidence interval by taking a larger number of samples (see Section 5.6.5).

**TABLE 1**
**TOXICITY LEVELS FOR METALS**
**(40 CFR 261 - as of November 1, 1993)**

| Element | Concentration, mg/l | EPA Hazardous Waste Number |
|---|---|---|
| Arsenic | 5.0 | D004 |
| Barium | 100.0 | D005 |
| Cadmium | 1.0 | D006 |
| Chromium (total) | 5.0 | D007 |
| Lead | 5.0 | D008 |
| Mercury | 0.2 | D009 |
| Selenium | 1.0 | D010 |
| Silver | 5.0 | D011 |

**5.8.3** If the waste is hazardous, it becomes subject to the provisions of the Resource Conservation and Recovery Act (RCRA). It must be treated to become non-hazardous before it can be landfilled. (See Section 8.5 for special considerations for lead.)

**5.8.4** Waste determined to be hazardous shall be disposed of as described in Section 6.

**5.8.5** Waste that is not hazardous according to the above should be disposed of in accordance with Section 7. The generator should also check state or local regulations to determine if the state has established any additional criteria for hazardous waste (see Section 8.4).

## 6. Procedures for Disposing of Hazardous Waste

If the analysis of lead-containing spent blasting media shows that it contains more than 5 mg/L of leachable lead, and no present or future alternative use as a raw material is practical or probable (see Section 8.1.2), it is then declared to be a hazardous waste. Preparations must be made to dispose of it as such. An EPA number is obtained, a disposal site is chosen, all containers are properly labeled, and the required manifests are prepared. An alternative is onsite treatment prior to disposal as presented in Section 6.4.

**6.1.1 EPA Identification Number:** A hazardous waste generator must obtain an EPA identification number. This is obtained from the state or local EPA office. Waste cannot be transported or disposed of without this number. The waste remains the property of the owner in perpetuity. For surface preparation debris, the owner of the structure from which the debris was created is considered to be the generator or cogenerator. The owner should obtain the EPA identification number, rather than the contractor who performs the work.

Provided by : www.spic.ir Licensee: NISOC Library

**6.1.2** Different types of EPA identification numbers are available. The owner should determine the appropriate type needed. The different types are:

**6.1.2.1** Regular - Permanent ID numbers are intended for facilities which will generate a hazardous waste on a long term, constant basis. Owners may desire to cover all of their facilities where lead-containing debris will be generated under one ID number.

**6.1.2.2** Site Specific ID numbers are intended for facilities which will generate a hazardous waste once. Owners may desire to identify each site, such as individual water towers, bridges, tank farms, etc., and have a unique ID number for each one.

**6.1.2.3** Provisional ID numbers are intended for unforeseen circumstances where a large amount (greater than 1,000 kg [2,200 lbs]) of hazardous waste is generated. An example would be clean-up of soil from an accidental spill of diesel fuel.

The owner may delegate obtaining Site Specific and Provisional EPA ID numbers to the contractor.

**6.2 DETERMINE TREATMENT AND DISPOSAL OPTIONS:** The generator must select a procedure or facility for treating and disposing of the waste. The choices are as follows.

- Ship the waste to a permitted treatment and disposal facility (see Section 6.3).
- Treat the waste on-site in accumulation containers to render it non-hazardous and then dispose of it as a non-hazardous waste (see Section 6.4).
- Reuse the waste as a raw material for another process (see Section 8.1.2), with proper approval.

In the vast majority of cases, the generator does not have the resources, knowledge, or inclination to treat waste on-site and will use an outside service. Procedures for off-site disposal are given in Section 6.3. Procedures for on-site treatment are given in Section 6.4.

**6.3 OFF-SITE TREATMENT AND DISPOSAL:** The waste can be shipped to a disposal facility or waste broker for treatment and disposal. The generator must identify the hazardous material present in the waste so the facility can treat it prior to disposal. Once treated and found to be below the regulatory limit, the material can be disposed of in a Subtitle C or D landfill. Specific procedures are as follows.

**6.3.1 Select Treatment and Disposal Facility:** There are numerous hazardous waste treatment facilities available in the United States. The state or regional EPA office can provide assistance in identifying these. The generator must inform the treatment facility of the quantity and hazardous nature of the waste, so the facility can treat it prior to disposal. It is the generator's responsibility to assure that the disposal facility is permitted and reputable.

**6.3.2 Select Hazardous Waste Hauler:** Hauling of the waste from the temporary storage site to the treatment, storage, or disposal (TSD) facility must be performed by a transporter having an EPA identification number. A list of licensed hazardous waste haulers can be obtained from the appropriate state agency (Appendix B).

**6.3.3 Prepare Manifest:** The generator of the waste must prepare a manifest (40 CFR Part 262.20). The manifest (Figure 1) must be obtained from the state where the waste is being disposed of, if that state requires its use. If the disposal state does not supply the manifest, the form from the state where the waste is generated should be used. If neither state requires a specific manifest, the form in Figure 1 can be used.

**6.3.4 Ship Waste and Retain Manifest**

**6.3.4.1** After the form has been completed, the generator must sign the manifest certification and obtain the signature of the initial transporter and date of acceptance. The generator keeps one copy, which must be retained for three years. If a signed copy is received from the designated facility which received the waste, this copy must be retained as a record for at least three years from the date the waste was accepted by the initial transporter. (Records should be retained indefinitely.) The remaining copies of the manifest are given to the transporter. There must be enough copies of the manifest for the generator, each transporter, the disposal facility, and the copy from the disposal facility to be returned to the generator within 45 days of the date of shipment (40 CFR Part 262.42).

**6.3.4.2** A large quantity generator, who has not received a signed copy of the manifest from the disposal facility within 35 days of acceptance of the waste by the initial transporter, must contact the transporter or owner of the designated facility to determine the status of the hazardous waste.

**6.3.4.3** A large quantity generator must submit an Exception Report to the EPA Regional Administrator if the signed copy of the manifest has not been received in 45 days. The Exception Report must include:

- A legible copy of the manifest for which the generator does not have confirmation of delivery.
- A cover letter signed by the generator or authorized representative explaining the efforts taken to locate the hazardous waste and results of these efforts.

**6.3.4.4** Small quantity generators have 60 days from

Provided by : www.spic.ir Licensee: NISOC Library

the time the waste was accepted by the transporter to receive the copy of the manifest signed by the disposal facility's representative. If no confirmation of delivery has been received in 60 days, the generator must then submit to state or regional US EPA authorities a legible copy of the manifest with some indication that the generator has not received confirmation of delivery.

**6.3.5 Biennial Report:** A generator who ships any hazardous waste off-site to a treatment, storage, or disposal facility must submit a Biennial Report to the U.S. EPA Regional Administrator by March 1 of each even numbered year (40 CFR 262.41). Many states require this report be submitted yearly rather than every two years. It must be submitted on EPA Form 8700-13A, and must include:

- The EPA identification number, name, and address of the generator.
- The calendar year covered by the report.
- The EPA identification number, name, and address for each off-site treatment, storage, or disposal facility to which waste was shipped.
- The name and EPA identification number of each transporter used for shipping to a treatment, storage, or disposal facility.
- A description, EPA hazardous waste number, DOT hazard class, and quantity of each hazardous waste shipped off- site.
- A description of the efforts undertaken during the year to reduce the volume and toxicity of waste generated.
- A description of the changes in volume and toxicity of waste actually achieved during the year in comparison to previous years, to the extent such information is available.
- The signature of the generator or authorized representative.

**6.4 ON-SITE TREATMENT AND DISPOSAL**

**6.4.1** General Requirements: Generators can treat the waste on-site in 90-day holding containers or tanks, if approved by the state or regional EPA office. A waste analysis plan (Section 6.4.3) must be submitted prior to treatment. The waste must be treated within the 90-day holding period (or longer) allowed for waste accumulation. Once the waste has been treated and is determined to be non-hazardous (e.g., leachable lead level below 5 mg/L as measured by TCLP), it can be disposed of at a Subtitle C or Subtitle D landfill.

**6.4.2 Treatments for Lead:** A number of treatment methods have been used on leadcontaining debris which have resulted in the treated waste having leachable lead levels below 5 mg/L when measured by TCLP. These processes are typically based on mixing the waste with Portland cement, lime, lime-fly ash, or silicates. Proprietary commercial treatments are available. Lead in sufficiently high concentration can be recovered in a lead blast furnace and reused in lead batteries or other reprocessing. Lead may also be incinerated. Appendix D presents information on treatment methods.

**6.4.3 Waste Analysis Plan:** On-site treatment requires filing a waste analysis plan with the regional EPA office or the state within 30 days prior to treatment by some mechanism that can verify delivery, i.e., return receipt requested, or by Federal Express or other messenger.

The waste analysis plan (40 CFR Part 264.13) must include:

- The parameters for which each hazardous waste will be analyzed and the rationale for these parameters.
- The test methods which will be used to test for these parameters.
- The sampling method which will be used to obtain a representative sample to be analyzed.
- The frequency with which the initial analysis of the waste will be reviewed or repeated to ensure that the analysis is accurate and up to date.

The generator is not required to obtain approval of the waste analysis plan prior to starting the on-site treatment, but the EPA can reject the plan at any time.

**6.4.4 Treat and Test Waste**

**6.4.4.1** The hazardous waste is then treated in accordance with the procedures selected in Section 6.4.2 and sampled in accordance with the plan in Section 6.4.3.

**6.4.4.2** The treated waste must be retested as described in Section 5.7 and reclassified as described in Section 5.8. If it is a non-hazardous waste, it can be disposed of as in Section 7. If it is still hazardous, it may be retreated as above or disposed of off site as described in Section 6.3.

## 7. Procedures for Disposing of Non-Hazardous Waste

**7.1 NON-HAZARDOUS WASTE:** Waste which has a leachable lead content of less than 5 mg/L as tested in Section 5.7 can be disposed of at a Subtitle D (non-hazardous) landfill. The waste may not be subject to the requirements of RCRA, but may be regulated by state and local waste regulations (see Section 7.3).

**7.2 TREATED WASTE:** Waste which has been treated on site and determined to be nonhazardous after treatment may be disposed of at a Subtitle D (non-hazardous) landfill.

Provided by : www.spic.ir Licensee: NISOC Library

The generator must submit a tracking document to the regional EPA office or authorized state office. The tracking document must include:

- Complete and accurate description of the waste, including its former hazardous waste classification.
- The identity and location of the Subtitle D facility where the waste has been sent.
- Available waste analysis data.

The tracking document is not sent to the disposal facility. Some states regulate nonhazardous, lead-containing wastes as a special, industrial, or residual waste. Only certain landfills may accept the waste. State hazardous waste offices should be contacted to determine if and how the waste is regulated (see Appendix B).

**7.3 STATE AND LOCAL RESTRICTIONS:** A number of states have special requirements for handling and disposing of waste containing less than 5 mg/L leachable lead or other materials which are not defined as hazardous by the EPA. The generator must consult the state or local environmental agency to determine if such rules are applicable. In addition, certain disposal or treatment facilities may have special requirements for handling or labeling these "special" wastes. Thus, the generator should not assume that because the waste has less than 5 mg/L leachable lead it can be disposed of at any sanitary or other non-hazardous landfill.

## 8. Commentary

The following supplementary notes provide additional guidance on the procedures described in Sections 4 through 7.

### 8.1 HAZARDOUS WASTE DEFINITION AND CLASSIFICATION

**8.1.1** There are a number of chemical elements whose land disposal is regulated. Some of these may be present in protective coatings or abrasives. As a result of the land disposal restriction portion of the Hazardous Solid Waste Amendments (HSWA), land disposal (i.e., burial in a landfill) of hazardous wastes is no longer permitted in the United States. The EPA has several criteria for determining whether a waste is hazardous. Certain wastes, known as "listed wastes," are automatically established to be hazardous. Waste is also designated as hazardous if it possesses any of the following four characteristics: ignitability, corrosivity, reactivity, or toxicity. The major concern for lead and other heavy metals is toxicity.

**8.1.2** It is important to remember that a material is not hazardous waste until it has been so declared. Even if the samples which have been tested are reported to contain 5 mg/L leachable lead or higher, the material does not automatically become a hazardous **waste**. It may have utility as a raw material for another use. However, it does become a hazardous **material**. If the lead-containing debris is being held for use as a raw material for some other process, it must be shipped from the site within 90 days. Such accumulation must be approved by the regulating state prior to actual accumulation.

**8.2 GENERAL PROCEDURE FOR HAZARDOUS WASTE DETERMINATION:** The generator of a solid waste must determine if that waste is hazardous. It must be determined whether the waste is excluded from regulation under RCRA. It must be determined whether the waste is listed as a hazardous waste. If the waste is not listed, it must be determined whether the waste is hazardous by testing for toxicity or other characteristics, or by knowledge of the hazardous characteristics. If the generator has sufficient knowledge of the waste characteristics based on prior sampling and testing of similar materials, the waste may be declared hazardous without any testing.

**8.3 TIME LIMITS FOR STORAGE OF WASTE ONSITE:** Once a material has been declared a hazardous waste, it must be treated or moved to a hazardous waste disposal facility within the allowed time limit as presented in 40 CFR Part 262.34. This limit may be 90, 180, 270, or an unlimited number of days depending on the weight of the material which has been declared a hazardous waste and whether it must be shipped over 200 miles (322 km) as presented in Section 5.5.1. For most surface preparation operations, 90 days is the maximum time material hazardous waste can remain in the temporary storage site. After material has been declared to be a hazardous waste, holding it in a storage area longer than the allowed time is illegal and makes the storage site an unpermitted hazardous waste storage facility.

**8.4 STATE REGULATION OF HAZARDOUS WASTE:** The regulations discussed are based on RCRA directives from the U.S. EPA. The state regulations must be at least as stringent as the Federal regulations. The states can establish more stringent requirements (lower threshold levels) for defining a toxic metal. States can also include other metals not included on the EPA list. For example, California and Michigan have defined toxic levels for zinc. For specific information, contact the state agency listed in Appendix B.

### 8.5 SPECIAL PROCEDURES FOR LEAD

**8.5.1** Lead and arsenic have been placed in a special category for testing purposes. The TCLP test (Method 1311) is used to determine if the waste is a hazardous material. If leachable lead level is 5 mg/L or greater, the EPTOX test (Method 1310) may be performed to determine

Provided by : www.spic.ir Licensee: NISOC Library

if it can be disposed of directly in a landfill. A waste having 5 mg/L or greater leachable lead as measured by TCLP but less than 5 mg/L leachable lead when measured by EPTOX can be disposed of directly at a Subtitle C (hazardous) landfill. Economics must be considered in deciding whether EPTOX testing and disposal at a Subtitle C landfill are selected, rather than treatment and disposal at a Subtitle D landfill.

**8.5.2** Lead- and arsenic-containing wastes which have 5 mg/L or greater leachable constituent by both TCLP and EPTOX, and wastes containing the other elements listed in Table 1, cannot be disposed in a landfill. The waste must be treated prior to disposal to a concentration below the level in Table 1.

**8.6** Additional sources of information are presented Appendix C.

## 9. Disclaimer

While every precaution is taken to ensure that all information furnished in SSPC guides, standards, and specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials or methods specified therein, or of the guide itself.

## APPENDIX A. DETERMINING CONFIDENCE INTERVAL OR HAZARDOUS WASTE ANALYSIS

The confidence interval is the safety factor required by EPA for determining that a waste is non-hazardous. Thus, the average value of the lead concentration plus the confidence interval (C.I.) must be less than 5 mg/L. First, the number of samples needed must be determined as follows:

1. Analyze four or more samples and determine the Standard Deviations.

$$S = [\sum(x_i - \overline{x})^2/(n-1)]^{1/2}$$

where $x_i$=value of each test result

$\overline{x}$ = average of the four samples

n = number of samples collected

2. Calculate the appropriate number of samples N by the following equation:

$$N_{(a)} = (t)^2 S^2 / RT - \overline{x})^2$$

where t = Student's "t" for 20 percent probability (Table 2)
RT = Regulatory Threshold (i.e., Toxicity Level, Table 1 )
$N_{(a)}$ = number of samples required

3. Once the number of samples is known and the proper number of samples have been analyzed, compute the confidence interval (C.I.).

$$C.I. = tS_x$$

where $S_x = S/n^{1/2}$

4. Calculate the leachable lead content as follows:
Leachable lead = x + C.I.

5. The result is then compared to the Regulatory Threshold limit to determine whether or not the samples tested represent a non-hazardous waste. Examples of calculations are given in JPCL, Vol. 7, No. 4, pp. 36-45 (1990).

**TABLE 2**
**TABULATED VALUES OF STUDENT'S "t"**

| n | t | n | t |
|---|---|---|---|
| 1 | 3.078 | 18 | 1.33 |
| 2 | 1.886 | 19 | 1.328 |
| 3 | 1.638 | 20 | 1.325 |
| 4 | 1.533 | 21 | 1.323 |
| 5 | 1.476 | 22 | 1.321 |
| 6 | 1.44 | 23 | 1.319 |
| 7 | 1.415 | 24 | 1.318 |
| 8 | 1.397 | 25 | 1.316 |
| 9 | 1.393 | 26 | 1.315 |
| 10 | 1.372 | 27 | 1.314 |
| 11 | 1.363 | 28 | 1.313 |
| 12 | 1.356 | 29 | 1.311 |
| 13 | 1.35 | 30 | 1.31 |
| 14 | 1.345 | 40 | 1.303 |
| 15 | 1.34 | 60 | 1.296 |
| 16 | 1.337 | 120 | 1.282 |
| 17 | 1.333 | | |

Note: The number of degrees of freedom (df) is equal to the number of samples (n) collected from a solid waste less one. Tabulated "t" values are for a two-tailed confidence interval and probability of 0.20. (The same values are applicable to a one-tailed confidence interval and probability of 0.10.)

## APPENDIX B. HAZARDOUS WASTE CONTACTS

ALABAMA
Alabama Dept. of Environmental Management
Land Division
1751 Congressman William L. Dickinson Dr.
Montgomery, AL 36130
205-271-7700

ALASKA
Dept. of Environmental Conservation
410 Willoughby Avenue
Juneau, AK 99801-1795

Provided by : www.spic.ir Licensee: NISOC Library

Program Manager: 907-465-5150

ARIZONA
Arizona Dept. of Environmental Quality
Office of Waste Programs
Hazardous and Solid Waste Section
3033 North Central Avenue
Phoenix, AZ 85012
602-207-2381

ARKANSAS
Dept. of Pollution Control and Ecology
Hazardous Waste Management Division
8001 National Drive
Little Rock, AR 72209
501-570-2872

CALIFORNIA
California EPA
Dept. of Toxic Substances Control
400 P Street, 4th Floor
P.O. Box 806
Sacramento, CA 95812-0806
916-323-6042

COLORADO
Colorado Dept. of Health
Hazardous Materials & Waste Management Division
4300 Cherry Creek Drive, South
Denver, CO 80222
303-692-3300

CONNECTICUT
Dept. of Environmental Protection
Waste Management Bureau
Waste Engineering and Enforcement Division
79 Elm Street
Hartford, CT 06106
203-566-5127

DELAWARE
Dept. of Natural Resources and Environmental Control
Hazardous Waste Management Branch
89 King's Highway
P.O. Box 1041
Dover, DE 19903
302-739-3689

DISTRICT OF COLUMBIA
Environmental Regulatory Administration
Pesticide, Hazardous Waste and Underground Storage Tank Division
2100 Martin Luther King Avenue, SE
Suite 283
Washington, DC 20020
202-404-1167

FLORIDA
Dept of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400
904-487-3299

GEORGIA
Georgia Dept. of Natural Resources
Environmental Protection Division
4244 International Parkway, Suite 30354
Atlanta, GA 30354
404-362-2537

HAWAII
Dept. of Health
Environmental Management Division
5 Waterfront Plaza, Suite 250
500 Ala Moana Boulevard
Honolulu, HI 96813
808-586-4424

IDAHO
Idaho Dept. of Health And Welfare
Division of Environmental Quality
1410 N. Hilton Street, 3rd Floor
Boise, ID 83706
208-334-5879

ILLINOIS
Illinois Environmental Protection Agency
Division of Air Pollution Control
2200 Churchill Road
Springfield, IL 62706
217-782-6760

INDIANA
Indiana Dept. of Environmental Management
105 S. Meridian Street
Indianapolis, IN 41225
317-232-3210

IOWA
Land Quality Bureau
Henry A. Wallace Bldg.
Des Moines, IA 50319
515-281-5145

KANSAS
Dept of Health and Environment
Bureau of Air and Waste Management
Forbes Field, Building 740
Topeka, KS 66620
913-296-1600

Provided by : www.spic.ir Licensee: NISOC Library

KENTUCKY
Natural Resources and Environmental Protection Cabinet
Division of Waste Management
18 Reilly Road
Frankfort, KY 40601
502-564-6716

LOUISIANA
Dept. of Environmental Quality
Hazardous Waste Division
7290 Blue Bonnet
Baton Rouge, LA 70884-2178
504-765-0261

MAINE
Dept. of Environmental Protection
Bureau of Hazardous Materials and Solid Waste Control
State House Station #17
Augusta, ME 04333
207-287-2651

MARYLAND
Dept. of Health and Mental Hygiene
Maryland Waste Management Administration
2500 Broening Highway
Baltimore, MD 21224
410-631-3304

MASSACHUSETTS
Dept. of Environmental Protection
Bureau of Waste Prevention
One Winter Street, 5th Floor
Boston, MA 02108
617-292-5589

MICHIGAN
Michigan Dept. of Natural Resources
Waste Management Division
P.O. Box 30241
Lansing, MI 48909
517-373-2730

MINNESOTA
Pollution Control Agency
Hazardous Waste Division
520 Lafayette Road, North
St. Paul, MN 55155-3898
612-643-3408

MISSISSIPPI
Dept. of Environmental Quality
Division of Solid and Hazardous Waste Management
P.O. Box 10389
Jackson, MS 39289
601-961-5171

MISSOURI
Missouri Dept. of Natural Resources
Solid Waste Management Program
205 Jefferson Street
Jefferson City, MO 65101
314-751-5401

MONTANA
Dept. of Health and Environmental Sciences
Solid and Hazardous Waste Bureau
P.O. Box 200901
Helena, MT 59620-0991
406-444-1430

NEBRASKA
Dept. of Environmental Quality
Air and Waste Management Section
1200 N Street, Ste.400
Lincoln, NE 68509
402-471-2186

NEVADA
Division of Environmental Protection
Waste Management Program
333 West Nye Lane
Carson City, NE 89710
702-687-5872 x 3042

NEW HAMPSHIRE
Waste Management Division
Department of Environmental Services
Health and Welfare Building
6 Hazen Drive
Concord, NH 03301-6509
603-271-2905

NEW JERSEY
Site Remediation Program
401 East State Street CN-028
Trenton, NJ 08625
609-292-1250

NEW MEXICO
Air Pollution Control Bureau
1190 St Francis Drive
Santa Fe, NM 87502
505-827-0047

NEW YORK
Dept. of Environmental Conservation
Division of Hazardous Substances Regulation
50 Wolf Road, Room 229
Albany, NY 12233-7250
518-457-6394

Provided by : www.spic.ir Licensee: NISOC Library

NORTH CAROLINA
Dept. of Environmental, Health, and Natural Resources
Hazardous Waste Section
P.O. Box 27687
Raleigh, NC 27611-7687
919-733-2178

NORTH DAKOTA
Dept. of Health
Consolidated Laboratories
Division of Waste Management
P.O. Box 5520
Bismark, ND 58502-5520
701-221-5166

OHIO
Ohio EPA
Division of Hazardous Waste
1800 Watermark Drive
Columbus, OH 43266-0149
614-644-2917

OKLAHOMA
Oklahoma State Dept of Environmental Quality
Waste Management Division
1000 N.E. Tenth Street
Oklahoma City, OK 73117-1212
405-271-5338

OREGON
Dept. of Environmental Quality
Hazardous Waste Division
811 S.W. Sixth Avenue
Portland, OR 97204
503-229-5913

PENNSYLVANIA
Dept. of Environmental Resources
Bureau of Waste Management
P.O. Box 8471
Harrisburg, PA 17105-8471
717-787-9870

RHODE ISLAND
Dept. of Environmental Management
Division of Air and Hazardous Materials
291 Promenade Street
Providence, RI 02908
401-277-2797

SOUTH CAROLINA
Dept. of Health and Environmental Control
Bureau of Solid and Hazardous Waste Management
2600 Bull Street
Columbia, SC 29201
803-734-5200

SOUTH DAKOTA
Dept. of Environment and Natural Resources
Office of Waste Management
523 East Capital Avenue
Pierre, SD 57501
605-773-3153

TENNESSEE
Environment and Conservation
Solid Waste Management
CUSTOMS HOUSE, 4th Floor
410 Church Street
Nashville, TN 37243-1535
615-543-0780

TEXAS
Texas Water Commission
Industrial and Hazardous Waste Division
P.O. Box 13087
Capital Station
Austin, TX 78711 -3087
512-908-2234

UTAH
Dept. of Environmental Quality
Division of Solid and Hazardous Waste
State of Utah
288 North 1460 West
Salt Lake City, UT 84114-4880
801-538-6170

VERMONT
Agency of Environmental Conservation
Hazardous Materials Management Division
103 South Main Street
Waterbury, VT 05671-0404
802-244-3888

VIRGINIA
Dept. of Waste Management
Monroe Building, 11th Floor
101 North 14th Street
Richmond, VA 23219
804-225-2667

WASHINGTON
Dept. of Ecology
Hazardous Waste & Toxics Reduction
300 Desmond Drive
Lacey, WA 98503
206-407-6700

Provided by : www.spic.ir Licensee: NISOC Library

WEST VIRGINIA
Division of Natural Resources
Waste Management Section
1356 Hansford Street
Charleston, WV 25301
304-348-5929

WISCONSIN
Dept. of Natural Resources
Solid and Hazardous Waste Management
101 S. Webster
Madison, WI 53707
608-266-0833

WYOMING
Dept. of Environmental Quality
Solid & Hazardous Waste Division
122 West 25th Street
Cheyenne, WY 82002
307-777-7752

## APPENDIX C. ADDITIONAL SOURCES OF INFORMATION

**1. Phone & Hotline Information**

- RCRA/Superfund Hotline
  1-800-424-9346 (in Washington, DC 260-3000)
- EPA Small Business Ombudsman Hotline
  1-800-368-5888 (in Washington, DC 557-1938)
- National Response Center
  1-800-494-8802 (in Washington, DC 260-2675)
- Transportation of Hazardous Materials
  202-366-4488
- Toxic Substance Control Act (TSCA) Assistance Service 202-554-1404
- Center for Hazardous Materials Research (CHMR) Hotline 1-800-334-2467

**2. EPA Documents**

- EPA/530-SW-86-019, September 1986, Under standing the Small Quantity Generator, Hazardous Waste Generator
- EPA/530-SW-037, November 1986, Solving the Hazardous Waste Problem - EPA's RCRA Program

**3. Journal of Protective Coatings and Linings** - available from Technology Publishing Co., 2300 Wharton St., Suite 310, Pittsburgh, PA 15203 (800-837-8303) .

**4. Other Publications**

- Bridge Paint Removal, Containment, & Disposal, Synthesis Report 20-05/20-09, 1992. Transportation Research Board, 2101 Constitution Ave., Washington, DC 20418
- Removal of Lead-Based Bridge Paints, NCHRP Report 265, December 1983, Transportation Research Board.
- Industrial Lead Paint Removal Handbook, 2nd Edition SSPC 93-02, July 1993.

## APPENDIX D. STABILIZATION METHODS

**D.1** The methods to stabilize lead in abrasive blasting debris include pre-treatments, in-process treatments and post-treatments. Pre-treatment consists of the use of abrasive additives.

These materials are added to the blasting abrasive before the waste is generated. The pretreatments, when added to the abrasive in the proper amount, result in a waste classified as non-hazardous when tested by the TCLP procedure. They can then be handled as a non-hazardous, lead-containing waste. In-process treatments are methods of treating airborne dusts such as the fines collected by a dust collector attached to a containment or an abrasive recycling system. Post-treatments are methods of stabilizing a lead-containing debris after the waste has been generated. The requirements presented in Section 6.4 describe the procedures which must be followed if onsite stabilization of a hazardous waste is performed.

**D.2 PRE-TREATMENTS**

**D.2.1** The abrasive additives with the greatest field history at time of the publication of this guide are steel grit and a proprietary cementitious material.

**D.2.2** Addition of 3-6 percent by weight of G-80 steel grit to expendable abrasives has resulted in leachable lead concentrations below 5 mg/L. The exact percentage is dependent on the leachable lead concentration of the waste without the additive, and source of the steel grit. The exact percentage can be determined by laboratory tests. The alternative is to add 10% percent steel grit by weight, as this amount has been shown to be sufficient, resulting in leachable lead concentrations usually less than 1 mg/L.

**D.2.3** Stabilization of lead with steel grit results from an oxidation-reduction reaction. Lead ions plate out on the steel particles during the TCLP. Abrasive blasting debris stabilized with iron has been tested using EPA Test Method 1320, Multiple Extraction Procedure. Leachable lead concentration increases measurably after each extraction. In the final extraction, the level has exceeded 5 mg/L. Long term stability is therefore questionable, and further stabili-

Provided by : www.spic.ir Licensee: NISOC Library

zation should be performed as described below in Section D.4 of this Appendix to minimize liability exposure under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

**D.2.4** A proprietary cementitious additive has a recommended addition rate of 15-18 percent by weight. Leachable lead concentrations of debris incorporating this additive at the recommended amount are about 0.1 mg/L. The stabilization method as identified by the manufacturer is pH control and encapsulation. Abrasive blasting debris stabilized with this material when tested by EPA Test Method 1320 has shown no increase in leachable lead concentration for ten (10) leaching cycles.

**D.2.5** Further stabilization of pre-treated waste can be performed with a posttreatment method as described in Section D.4 of this Appendix. The requirements in Section 6.4 of the Guide do not apply as long as the waste is classified as nonhazardous.

### D.3 IN-PROCESS TREATMENTS

**D.3.1** Although state regulations may vary, the US EPA generally does not consider airborne dusts to be wastes until they are collected, as long as these dusts remain in a closed structure (dust collector). Addition of treatment chemicals in an acceptable manner **before collection** has been allowed as a process change or as a totally enclosed treatment (TET) by US EPA and a number of states.

**D.3.2** Proprietary admixtures and injection equipment have been developed and used to generate non- hazardous waste for the fines collected in dust collectors. The process consists of injection of a powdered admixture into the air stream containing the dust. The admixture chemistry and amount to be added varies and the supplier must be contacted to determine the proper material and addition rate.

**D.3.3** Although these wastes may pass the TCLP test, they can be further stabilized with post-treatment methods described in Section D.4 of this Appendix. The requirements of Section 6.4 of the Guide do not apply as long as the waste is classified as non-hazardous.

### D.4 POST-TREATMENTS

**D.4.1** Common post-treatment methods include use lime or portland cement.

**D.4.2** Lime stabilizes lead-containing debris by pH control. Addition of lime is effective at a level of about a 10-15 percent by weight. Lead compounds are amphoteric, meaning they are soluble in acidic and alkaline solutions. Adding too much lime will raise the pH, and may result in a leachable lead concentration above 5 mg/L. Laboratory testing is needed to determine the proper amount of lime to add. No tests of long term stability (EPA Method 1320) are known.

**D.4.3** Stabilizing lead with portland cement can be performed either as a dry addition, or with water to make concrete. Adding portland cement at a level of 10 percent by weight or higher typically results in very low leachable lead concentrations, usually 0.05-0.10 mg/L. Concretes can be made using a water/cement ratio of 0.5. A representative mixture design to form blocks is 300 pounds of debris, 94 pounds (one sack) of cement, and 7.5 gallons of water. Wastes stabilized in this manner have been evaluated for long term stability by EPA Method 1320 and show no increase in leachable lead concentration for ten (10) cycles.

**D.4.4** Fine-grained wastes such as dust from dust collectors or the fines from steel recycling units have been success fully stabilized with portland cement. However, more water must be added to the mixture for these wastes. The mixture design in Section 4.3 is not appropriate for fines. Laboratory tests must be performed to determine an adequate amount of water. Fines from dust collectors may be classified as a hazardous waste unless in-process treatment was performed.

Provided by : www.spic.ir Licensee: NISOC Library

Please print or type *(Form designed for use on elite (12 - pitch) typewriter)* *Form Approved. OMB No. 2050 - 0039 Expires 9 - 30 - 91*

# UNIFORM HAZARDOUS WASTE MANIFEST

1 Generator's US EPA ID No. | Manifest Document No. | 2. Page 1 of | Information in the shaded areas is not required by Federal law

## GENERATOR

3. Generator's Name and Mailing Address

4. Generator's Phone ( )

A. State Manifest Document Number

B. State Generator's ID

5. Transporter 1 Company Name | 6. US EPA ID Number

C. State Transporter's ID

D. Transporter's Phone

7. Transporter 2 Company Name | 8. US EPA ID Number

E. State Transporter's ID

F. Transporter's Phone

9. Designated Facility Name and Site Address | 10. US EPA ID Number

G. State Facility's ID

H. Facility's Phone

| 11. US DOT Description *(Including Proper Shipping Name, Hazard Class, and ID Number)* | 12. Containers No. | 12. Containers Type | 13. Total Quantity | 14. Unit Wt/Vol | I. Waste No. |
|---|---|---|---|---|---|
| a. | | | | | |
| b. | | | | | |
| c. | | | | | |
| d. | | | | | |

J. Additional Descriptions for Materials Listed Above

K. Handling Codes for Wastes Listed Above

15. Special Handling Instructions and Additional Information

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; **OR,** if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name | Signature | *Month* *Day* *Year*

## TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name | Signature | *Month* *Day* *Year*

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name | Signature | *Month* *Day* *Year*

## FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in item 19.

Printed/Typed Name | Signature | *Month* *Day* *Year*

**EPA Form 8700 - 22 (Rev. 9 - 88) Previous editions are obsolete.**

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC: The Society for Protective Coatings

# GUIDE 9

## Guide for Atmospheric Testing of Coatings in the Field

### 1. Scope

**1.1** This guide covers the procedures for planning, performing, and documenting field evaluations of atmospheric testing of coatings applied to steel panels or steel structures.

**1.2** It is intended for coating systems applied to new or previously coated structures.

**1.3** It is intended for use by coatings specifiers, end users, manufacturers, formulators, and test laboratories.

### 2. Description

**2.1 USE OF GUIDE:** Coating field evaluation data developed in accordance with this guide may be used to document field performance requirements of SSPC specifications, facility owner specifications, or other purchaser documents. SSPC specifications with field performance requirements include Paints 28, 29, 31, 34 and 36, and Painting System 24.

**2.2 CONTENT OF GUIDE:** The procedures for planning, performing, and documenting field evaluations are organized into the following steps, as outlined in Appendix A:

- Establish Scope and Objectives of Field Testing Program (Section 4)
- Select and Identify Coating Systems (Section 5)
- Select and Characterize Test Structure (Section 6) Apply Coatings (Section 7)
- Design Periodic Rating and Inspection Procedure (Section 8)
- Perform Field Inspection and Rating (Section 9)
- Assess and Analyze Data (Section 10)

### 3. References

**3.1** The standards referenced in this guide are listed Sections 3.2 through 3.4 and form a part of this guide.

**3.2 SSPC AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Paint Thickness with Magnetic Gages |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **Paint 28** | Water-Borne Epoxy Primer for Steel Surfaces |
| **Paint 29** | Zinc Dust Sacrificial Primer, Performance-Based |
| **PS 24.00** | Latex Painting System for Industrial and Marine Atmospheres Performance-Based |
| **SP 1** | Solvent Cleaning |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 7/NACE No. 4** | Brush Off Blast Cleaning |
| **SP 10/NACE No. 2** | Near White Blast Cleaning |
| **SP 11** | Power Tool Cleaning to Bare Metal |
| **VIS 1-89** | Visual Standard for Abrasive Blast Cleaned Steel |
| **VIS 2** | Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces |

**3.3 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **A 36** | Specification for Structural Steel |
| **D 523** | Method for Specular Gloss |
| **D 610** | Method of Evaluating Degree of Rusting on Painted Steel Surfaces |
| **D 660** | Method for Evaluating Degree of Checking of Exterior Paints |
| **D 714** | Method of Evaluating Degree of Blistering on Painted Steel Substrates |
| **D 1654** | Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments |
| **D 1729** | Practice for Visual Evaluation of Color Differences of Opaque Materials |
| **D 3359** | Methods for Measuring Adhesion by Tape Test |
| **D 4214** | Method for Evaluating Degree of Chalking of Exterior Paints |
| **D 4417** | Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel |
| **D 4541** | Method for Determining Pull-Off Strength of Coatings Using Portable Adhesion Testers |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **D 4940** | Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasive |
| **D 5065** | Guide for Assessing the Condition of Aged Coatings on Steel Surfaces |
| **F 1133** | Practice for Inspecting the Coating System of a Ship's Underwater Hull and Boottop During Drydocking |
| **G 92** | Practice for Characterization of Atmospheric Test Sites |

**3.4 NACE INTERNATIONAL STANDARDS:**

| | |
|---|---|
| **RP0287** | Standard Recommended Practice for Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape |

## 4. Establish Scope and Objectives of Field Testing Program

**4.1 ESTABLISH OBJECTIVES:** The evaluator should prepare a short written statement on the objectives of the field evaluation. Examples of objectives are as follows:

- To compare new coatings with standard (reference) coatings used by a facility.
- To evaluate the merits of a variety of new coatings for field practicality and performance.
- To evaluate the influence of surface preparation and coating application variations on coating performance.

Specific items to be addressed in the statement include:

- The intended exposure environment.
- The approximate or desired service life (e.g., comparison with standard).
- The type of structure.
- The condition of the steel.
- The primary functions of coatings (e.g., to provide corrosion protection, good appearance, and identification or safety related information).

It is recommended that the objective statement be signed or authorized by appropriate supervisory or management personnel.

**4.2 DETERMINE SCOPE OF TESTING PROGRAM:** The evaluator should identify the general nature of the test program, including the type of candidate and control coatings, the intended exposure environment, and the type of structure.

**4.2.1 Coating Systems**

**4.2.1.1 Candidate Coating:** Identify the types of coatings to be evaluated (e.g., low-VOC alternatives or one-coat epoxy mastics), including type and thickness of primer, intermediate coat and topcoat (as appropriate), and total film build. Also identify the sources of the candidate coatings (e.g., submissions to a Qualified Product List [QPL]), new proprietary products, or newly developed laboratory formulations). Adequate data to support special performance requirements, such as chemical resistance, should be available prior to field testing.

**4.2.1.2 Control Coating:** Include a control coating in the test to help account for the affect of the local environment on the coating performance. The specific control coating materials should be identified (e.g., standard coating in use at facility should be identified by brand and generic name or by Federal or SSPC specification). In addition, include a short explanation of why this particular control coating has been selected.

**4.2.1.3 Surface Preparation:** An important part of the coating system is the type of surface preparation to be evaluated in the program (e.g., blast cleaning or hand- or power-tool cleaning) and the specific degree of cleaning.

**4.2.1.4 Regulations:** Ensure that the materials and procedures selected comply with all local regulations. In addition, consider the impact of tests upon surrounding facilities and the local environment.

**4.2.1.5 Exposure Environment:** Identify the types of exposures for which the coatings are intended. An SSPC classification procedure may be used. If the environmental exposure zone is not one that is listed in Note 13.1, identify the specific type of chemical or condition (e.g., fumes, deicing salts, or waste treatment plant peroxide fumes).

**4.2.1.6 Surface Condition of Steel:** Identify the surface condition of the steel to which each coating is to be applied, e.g., whether it is a new or existing surface and the degree of pitting and salt contamination. If the surface is coated, measure the dry film thickness and adhesion of the coating.

**4.2.1.7 Structure Type:** Identify the structure type (e.g., bridge, floor, or tank) or structural details desired (e.g., lattice work, crevices, or floating tank roof), including the type of steel, whether it is new or has been previously painted, and the area to be painted.

## 5. Select and Identify Coating Systems

**5.1** This step is to identify, describe, and determine the sources of the candidate coating materials and the controls.

Provided by : www.spic.ir Licensee: NISOC Library

In addition, the specific surface preparation and application details are to be established, along with any other special requirements.

**5.2 COATING SYSTEM:** The test will normally include candidate coating systems and control or reference coating systems. Together, the surface preparation procedure, coating materials, and application method make up a coating system. For each of the candidate and control coating systems, provide the following information:

**5.2.1 Surface Preparation.** The surface preparation for the test should be that expected to be done for a full-scale job application. Applicable SSPC standards include SSPC-SP 1 (Solvent Cleaning), SSPC-SP 2 (Hand Tool Cleaning), SSPC-SP 3 (Power Tool Cleaning), SSPC-SP 6/ NACE No. 3 (Commercial Blast Cleaning), SSPC-SP 7/ NACE No. 4 (Brush-Off Blast Cleaning), SSPC-SP 10/ NACE No. 2 (Near-White Blast Cleaning), and SSPC-SP 5/ NACE No. 1 (White Metal Blast Cleaning).

Certain preparation methods may require additional information such as the surface profile and method of measuring profile, the type and qualification of abrasive, and specific equipment or components such as nozzles, compressors, filters, and pressure for water jetting.

**5.2.2 Coating Materials.** The minimum information required for all coatings is the generic (chemical) type, number of components, volatile organic compound (VOC) content, recommended dry film thickness (DFT), number of coats, and the specific source of the product (e.g., brand name, or government or SSPC paint specification). Other physical properties that may be useful are the volume percent solids, theoretical spreading rate, active pigments (e.g., corrosion-inhibiting or sacrificial), dry time, and flexibility. Prior to the application of the coating, the evaluator must obtain product data sheets for application instructions and an MSDS for handling and safety instructions.

**5.2.3 Application.** The application procedure that would be used for full-scale application of the coating should be selected. If another procedure is used, consideration must be given to its effect on coating performance. Any application procedure must be approved by the coating manufacturer. Determine what information is to be monitored and recorded. The minimum information required is the application procedure, ambient weather conditions when the coating was applied, including air and surface temperatures, humidity and dew point, and time intervals after surface preparation and before painting, as well as between coats. Other information, such as the manufacturer of the spray equipment, may be desirable.

## 6. Select and Characterize Test Structure

**6.1 SELECT STRUCTURE AND APPROPRIATE ENVIRONMENT:** Based on the requirements set out in the planning stage, select a structure or structures in the appropriate exposure environment. Because of the limited availability of sites and access to structures, it is not always possible to match the exposure conditions proposed in the planning stage. Document the structure, test locations, and other local conditions that may affect the test with photographs and written records. A model report form is found in Appendix B.

When selecting a structure, the following points should considered:

- Authorization to use for testing
- Clearances and access for application
- Access for inspection
- Security
- Condition of steel and configuration
- Environmental impact
- Expected duration of test site
- Direction of exposure for gloss retention studies

**6.2 SELECT STRUCTURAL COMPONENTS FOR TESTING**

**6.2.1** Select a portion of the structure for the coating testing program. The portion should be readily dividable into a minimum of two locations. The different locations should be relatively similar in surface condition, exposure, corrosivity (e.g., exposure to chemicals, water runoff, and saltwater runoff), and structural configuration. The test location for each coating system should be picked at random. Test each coating system, including candidates and controls, in more than one location since the reliability of the results increases as the number of replicates increases. This will also permit comparisons of candidate coatings with control coatings and with one another. Document the selection with photographs.

**6.2.2** Three levels of field site evaluations have been established:

**Level A - Production Scale Structure Evaluation:** Each test area should be a minimum of 40 square feet (4 $m^2$). The area should include a variety of configurations representative of the actual structural surface, such as planar areas, edges, and welded or bolted connections.

**Level B - Patch Scale Structure Evaluation:** Each test area should be a minimum of 6 square feet (0.6 $m^2$). If possible, at least two linear feet (0.6 m) of edge should be included in the test. Where early results are sought, scribes may be placed in three to five locations on the flat areas. With small areas, it is important that each candidate and each control system be applied on the most uniform area that can be found.

**Level C - Test Panel Evaluation:** Where suitable structural surfaces are not available, or where there are a

Provided by : www.spic.ir Licensee: NISOC Library

relatively large number of systems to be evaluated, test panels may be used. Test panels should be a minimum of 4 by 6 inches (100 by 150 mm) in area, at least 1/8 inch (6.4 mm) thick. They should be made of hot-rolled steel meeting the requirements of ASTM A 36 unless otherwise agreed upon. Alternatively, use hot-rolled steel similar to the steel in structures to be coated. A minimum of four replicate test panels for each coating system or control system is recommended. The panels may be placed on test racks on the ground, on test racks suspended from the structure, or individually suspended from structures. The location of each panel on the rack or elsewhere should be chosen at random. Electrical insulation of the panels from a structure or other support must be assured.

**6.3 CHARACTERIZE EXPOSURE ENVIRONMENT:** Exposure environments can be characterized by the environmental parameters or by the performance of standard materials in that environment. The SSPC zones provide a broad classification of exposure environments (see Note 13.1).

**6.3.1 Environmental Parameters.** These include relative humidity, rainfall, temperature averages and ranges, acidity of rainfall, and the presence of contaminants such as chemicals or salts. The time of wetness, which is an important factor in determining corrosion rates, can be measured. The total ultraviolet radiation can be measured or the number of hours of sunlight can be estimated based on the direction of the exposure and weather data. Additional information on the weather and local environment can be obtained from the U.S. Environmental Protection Agency (EPA), the National Oceanic Atmosphere Administration (NOAA), the U.S. Meteorological Society, or by specialized monitoring equipment.

**6.3.2 Performance of Standard Materials.** The most common indicator of corrosion rates is the corrosion of bare steel coupons. A minimum corrosion rate of 1.0 mil (25 micrometers) per year is recommended for classification as a moderate exposure environment. ASTM G 92 provides a method for site calibration. Other parameters used are the corrosion rate of bare zinc and the lifetimes of certain standard reference paints. Another potentially useful parameter is the scribe undercutting rate of vinyl paints or systems with well-defined characteristics.

**6.4 CHARACTERIZE CONDITION OF STRUCTURE COATING:**

**6.4.1 Rust, Pitting, and Contaminants.** The test surface should be examined to determine the extent of corrosion and rust scale (SSPC-VIS 2/ASTM D 610), and pitting of the steel. The presence of any visible salts, other contaminants and defects on the surface should be noted. (See Section 6.4.4 for identifying soluble salts.)

**6.4.2 General Condition of Existing Coating.** Types of existing coatings (i.e., primer, intermediate, topcoat) should be recorded. A visual rating of the coating condition should be obtained. The physical condition of the existing coating (e.g., adhesion, brittleness) should be examined.

**6.4.3 Detailed Condition of Existing Coating.** A pre-characterization inspection is more critical for coatings that are to be applied over intact rust, pitted steel; or existing coatings, than over clean bare steel. Detailed descriptions for assessing the condition of painted steel can be found in ASTM D 5065 or ASTM F 1133 (see 8.2.1 and 8.2.6). An abbreviated form for reporting the condition of the existing surface is found in Appendix B. Photographs should be used to help document these conditions. When adhesion is measured, both the test method used and the results obtained should be recorded.

**6.4.4 Soluble Salts.** For surfaces thought to be contaminated with salts, the concentration of salts can be measured using commercially available field testing kits. The type of kit used and the concentration measured should be recorded. For coatings to be applied over blast cleaned steel, recommended procedures are available for inspection after blasting. (See Appendix F from Report FHWA RD-91-011 [SSPC 91-01].)

## 7. Apply Coatings

A summary of documentation requirements is provided in Section 7.6. Each of the requirements is described in the appropriate section. A model application form is illustrated in Appendix C.

**7.1 PREPARE JOB SPECIFICATION:** As with any other field application, it is essential to prepare written requirements or specifications for the application. These include general instructions for contractors or other applicators, identification and location of the structure and test area, surface preparation and coating application requirements, limitations due to weather conditions, and inspection requirements and responsibilities.

**7.2 OBTAIN AND TEST COATING MATERIALS:** The evaluator must stipulate who will supply the coatings, and who will verify that the coatings meet the requirements established earlier. The supplier should be required to provide results of quality control tests on viscosity, density, gloss, and dry time. in addition, an infrared spectroscopic fingerprint of the coating applied could be required to verify that the correct resin system was used. These requirements are necessary to help ensure that a coating applied at a later time is the same formulation as the one used in the field test. The evaluator should also ensure that the application data sheet and the MSDS, along with the required thinners and the clean-up solvents, are available.

Provided by : www.spic.ir Licensee: NISOC Library

**7.3 PERFORM PRELIMINARY INSPECTION:** Assess the condition of the structure and areas to be used for testing. In some cases, the final selection of the areas to be coated will be made at the time of application. If coating and rust are not to be completely removed, document the condition with photographs. Identify and mark the areas for each system to be tested.

Record the environmental conditions, including air temperature, steel temperature, relative humidity, dew point, wind, etc.

**7.4 PREPARE SURFACE:** The surface shall be prepared in accordance with the job specification and inspected for conformance. Record the type of abrasive used, contamination level of abrasive (ASTM D 4940 can be used to assess ionic content), and the surface profile of the steel (ASTM D 4417 or NACE RP0287). Document the appearance of the surface using SSPC-VIS 1-89.

**7.5 APPLY COATING:**

**7.5.1** The coating should be applied in accordance with SSPC-PA 1, the manufacturer's instructions, and the job specifications.

Observe and record the following aspects of the coating:

- the condition of the coating in the container
- the mixing method
- the induction time
- the pot life, if two or more components are being mixed
- the amount and type of thinning
- the dry time
- the recommended time between coats
- general application techniques

Following the application of each coat, inspect the film for dry spray, sagging, running, or other application film defects. It is essential that the film thickness of the coatings conform to the specification and that the coatings are applied uniformly.

Measure and record the dry film thickness of each coat in accordance with SSPC-PA 2. Document ambient conditions and parameters of the application equipment, if appropriate.

**7.5.2** Scribing a coating to expose the substrate is frequently done on test panels, but it is not commonly done on existing structures. Although there is reluctance to create an area on the structure that will require subsequent repair, significant benefits are obtained by scribing. Performing scribing on the structure will provide information on the coating's ability to resist further breakdown at a damaged area and will produce coating system degradation faster than in an undamaged area. Scribing may be done in accordance with ASTM D 1654.

**7.5.3** The manufacturer should be invited to observe the field application and coating inspection.

**7.6 DOCUMENTATION SUMMARY:** An evaluator should ensure that the following records have been obtained:

a. Description of the surface coated, including the type and condition of the steel, the extent of corrosion and pitting, the presence of salts or other surface contaminants, the size of the test patch or the size and number of test panels, and the type and condition of the existing coating, if any.

b. Description of the surface preparation procedure, including abrasive type, profile, and other parameters, as required.

c. Weather conditions during surface preparation, coating application, film drying, and curing.

d. Product IDs, batch numbers, manufacturers' names on all paints and other materials used.

e. Records of coating condition in container, thinning, application procedures, parameters, and equipment, and any film application defects, such as sagging or dry spray.

f. Records of DFTs (single coat and system).

g. Samples of paint, abrasives, and replica tapes, as required.

h. Photographs of initial conditions, operations, and completed test areas.

i. Names, affiliations, and phone numbers of observers, representatives, and inspector.

j. After an appropriate cure time, adhesion should be assessed, using methods such as ASTM D 3359 or ASTM D 4541. (See Note 13.2.)

## 8. Design Periodic Rating and Inspection Procedure

**8.1 SCHEDULING:** Prepare a schedule for rating and inspection. Suggested intervals are 6 months, 12 months, 18 months, 24 months, and yearly thereafter. For especially severe environments or where early degradation analysis is required, the first inspection may be scheduled after 2 to 3 months. The program should be scheduled to run for a fixed period of time, or until the coating reaches a defined level of performance.

**8.2 EVALUATION PARAMETERS:** The evaluator should establish test parameters to rate the coating. These are often tied into the test objectives. Coating performance is usually evaluated in terms of corrosion protection and appearance.

**8.2.1 Rusting on Flat Surfaces:** It is important to provide a quantitative assessment for comparison with subsequent ratings or alternate systems. The most common method is SSPC-VIS 2 (ASTM D 610), which provides

Provided by : www.spic.ir Licensee: NISOC Library

a numerical scale based on the percent of the surface rusted. This test is most useful for small areas (up to 1 square foot [0.09 $m^2$]). Larger areas should be divided into small uniformly sized areas to determine the rating of each small square. ASTM F 1133 describes an evaluation procedure, using a series of illustrations as reference, to determine the extent and level of deterioration. Another simple approach is to estimate the total percentage of the area that has deteriorated to a condition worse than a defined ASTM level (e.g., rust grade 8).

**8.2.2 Edge Rusting.** Edge rusting is usually reported as a percentage of the linear feet rusted.

**8.2.3 Undercutting at Breaks or Scribes.** The average or maximum distance of undercutting at breaks or scribes is usually reported in millimeters or fractions of an inch (e.g., 1/32 inch).

**8.2.4 Blistering.** This occurs most frequently in SSPC Atmospheric Zones 2A (frequently wet with fresh water) and 2B (frequently wet with salt water). The standard method for evaluating blisters is ASTM D 714, which rates both the size and the frequency of the blisters. It may be necessary to subdivide large areas into smaller, more uniform areas, or to devise a scheme similar to those described in Section 8.2.1 for surface rusting. (See Note 13.3 for special requirements regarding thick film coatings.)

**8.2.5 Appearance**

**8.2.5.1** The most important appearance parameters are color and gloss retention. These are best measured using specific field-compatible instruments. Information on these parameters can also be obtained by retaining unexposed samples in the lab and visually comparing the appearance of the two surfaces using ASTM D 523 and D 1729.

**8.2.5.2** Other appearance defects to be evaluated are chalking (ASTM D 4214) and bleeding.

**8.2.6 Film Deterioration.** Film deterioration modes include checking, cracking, erosion, flaking, peeling, and loss of adhesion. Standard procedures using photographic standards and field measurements are described in ASTM D 5065. However, the adhesion measurement procedures described (ASTM D 3359 and D 4541) are destructive tests and may necessitate repair of the coating system.

**8.3 ESTABLISH PERFORMANCE AND FAILURE CRITERIA:** In many cases it is important to determine a time-to-failure. This would require a definition of coating system failure, which may depend on the service exposure. Examples of failure criteria are listed below.

- Average rust rating of 7, based on SSPC-VIS 2 (ASTM D 610).
- 20% of the surface showing signs of degradation of topcoat or needing surface preparation.
- Average scribe undercutting of 4/32 inches (3.2 mm) or 8/32 inches (6.4 mm).
- Average adhesion rating less than 3B (ASTM D 3359).
- Average gloss retention of 50% or less of the original gloss reading.
- Average blister rating less than 8M (ASTM D 714).
- Poorer performance than the control at some predetermined service time. (Performance parameters should be stated explicitly.)

**8.4 DESIGN RATING FORMS FOR FIELD:** The evaluator should prepare a set of instructions for the field evaluation, including the parameters to be measured, the methods to be used, photographs to be taken, and the standards to be used. In addition, the evaluator should prepare preprinted rating forms for field inspection. A model inspection and rating form is shown in Appendix C.

## 9. Perform Field Inspection and Rating

**9.1** Identify the structure, its location, and date of inspection. This should be done far enough in advance of the field inspection to ensure that all interested parties can attend.

**9.2** Assemble an inspection team, including an owner's representative and a manufacturer's representative.

**9.3** Arrange for the necessary access, clearance permits safety equipment, and inspection equipment.

**9.4** Prepare and distribute ratings forms for field evaluation.

**9.5** Conduct inspection in accordance with plans.

**9.6** Record data on appropriate forms. Obtain signatures of participants and observers. Take photographs, as required.

**9.7** Record environmental conditions and other damaging factors that might affect the performance of the coatings (e.g., salt dripping, abrasion, wind, and vandalism).

## 10. Assess and Analyze Data

**10.1** Tabulate and evaluate the data from each inspection. Data should be organized to show:

- Ratings of each coating system's performance at each inspection.

Provided by : www.spic.ir Licensee: NISOC Library

- Other performance evaluation information at each inspection.

**10.2** Identify the types of degradation or failures that occurred for the systems tested.

**10.3** Plot the various performance levels over time.

**10.4** Compare candidates to defined performance levels in the following ways:

- Compare with control coating performance.
- Assess whether the candidate coating meets, exceeds, or falls short of the minimum performance criteria established.
- Determine whether insufficient time has elapsed to evaluate the acceptability of candidate coatings.
- Provide explanations for certain field data not considered valid.

**10.5** Based on the data above, determine if additional inspection and rating is required. If so, estimate the time for the next planned rating.

## 11. Safety

This guide may involve hazardous materials, operations, and equipment. Proper safety precautions must be observed. Follow all applicable Federal, State, and local regulations. Handle materials safely in accordance with the manufacturer's Material Safety Data Sheets (MSDS), Product Data Sheet and label. Refer to SSPC-PA Guide 3.

## 12. Disclaimer

While every precaution is taken to ensure that all information furnished in SSPC guides is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, paints, or methods specified therein, or of the guide itself.

## 13. Notes

**13.1** The SSPC Environmental Exposure Zones include: 1A (interior, normally dry), 1B (exterior, normally dry), 2A (wet by fresh water), 2B (wet by salt water), 3A (chemical exposure -- acid), 3B (chemical exposure -- neutral), 3C (chemical exposure -- basic), 3D (chemical -- mild solvent), and 3E (chemical -- strong solvent).

**13.2** Results from different adhesion tests may not be comparable, because different properties are being measured. Refer to ASTM D 3359 and ASTM D 4541 regarding interpretation of results and precision.

**13.3** For thick film coatings (>10 mils [250 micrometers]), inspection procedures using ASTM D 610 and ASTM D 714 may be inadequate. Blisters, film delamination, and underfilm rusting may not be detected. Hence, probing with a knife or removal of coatings may be required upon the completion of the test to inspect for delamination and underfilm rusting. Adhesion testing may also be applicable upon completion of the test.

## APPENDIX A. CHECKLIST FOR PLANNING AND CONDUCTING FIELD EVALUATION OF A COATING SYSTEM

1. Establish program objectives.
2. Establish program scope, including:
    - number and generic types of coating systems
    - surface condition of steel
    - type and location of structure
    - exposure environment sought
    - evaluation frequency
3. Select structure, considering:
    - type
    - location
    - type and surface condition of steel
    - new or repaint (if repaint, describe existing coating)
    - accessibility
    - location and size of test area
4. Select surface preparation, including:
    - type (abrasive blasting, water jetting, etc.)
    - description (in accordance with SSPC surface preparation standards)
    - abrasive and profile
    - other requirements (type of equipment, pressures, etc.)
5. Identify test and control coatings (primer, intermediate, topcoat), including:
    - generic type
    - description (brand name and specification number)
    - recommended DFT
    - application method
    - VOC content
    - weather requirements for application
    - recoat/service time
    - review MSDS and product data sheets
    - other
6. Prepare written specifications and obtain contractor.
7. Obtain and conduct quality control tests of coating materials.
8. Conduct preliminary inspection of structure.
9. Arrange for appropriate people to be present for application and inspection.

Provided by : www.spic.ir Licensee: NISOC Library

10. Observe and record surface preparation and application parameters and weather conditions. Document with photographs.
11. Inspect and rate condition of coating systems: Assemble inspection team. Obtain necessary access, permits, inspection equipment. Prepare inspection forms. Record data. Take and identify photographs. Obtain signatures of participants and observers.
12. Evaluate data:
    - Tabulate and organize inspection data.
    - Compare level of performance to criteria.
    - Determine if additional testing is needed.

Provided by : www.spic.ir Licensee: NISOC Library

## APPENDIX B
## DESCRIPTION OF TEST STRUCTURE

(One form needed for each test patch)

Inspector: _____ Date: _____

Type of Structure: _____ Identification: _____

Facility/Route No.: _____

Location (city/state): _____

Exposure (SSPC Zone): _____ Bare Steel Corrosion Rate: _____

Other (industrial, marine, urban, specific chemicals): _____

Location of test patch on structure: _____

Description of test patch surface: _____

Size of test patch: _____

Extent of corrosion and pitting: _____

(Vis 1-89 rating: _____ )

(general condition*: _____ )

Presence of salts: (Type of test: _____ ) (Unit: _____ )

Existing coating type:

Condition: (Rust, Vis 2: _____ ) (Peeling: _____ ) (Other: _____ )

Thickness (mils): Average: _____ Range: _____

Adhesion: Type of test/unit: _____ Average: _____ Range: _____

Remarks:

* See SSPC 91-01, Appendix F for information on characterizing surfaces contaminated with soluble salts.

Provided by : www.spic.ir Licensee: NISOC Library

## Appendix C

## Application

| | | |
|---|---|---|
| ApplicatorName: | | |
| Company: | Phone: | |
| Inspector Name: | | |
| Company: | Phone: | |
| Owner Representative Name: | | |
| Company: | Phone: | |
| Position of Responsibility: | | |
| Coating Supplier Name: | | |
| Company: | Phone: | |
| Surface Preparation: | | |
| Date: | Method/Degree of Cleaning: | |
| Abrasive Used: | Profile: | Measured by: |
| Comments: | | |
| Ambient conditions (describe): | | |
| Surface Temperature: | Air Temperature: | |
| Relative Humidity: | Other: | |

Provided by : www.spic.ir Licensee: NISOC Library

**COATING APPLICATION**

| | Primer | Intermediate | Topcoat |
|---|---|---|---|
| Product Name and Number: | | | |
| Generic Type | | | |
| Batch Number/Date | | | |
| Environmental Conditions | | | |
| Air Temperature | | | |
| Surface Temperature | | | |
| Relative Humidity | | | |
| Dew Point | | | |
| Wind Conditions | | | |
| Condition in Container | | | |
| Number of Components | | | |
| Method of Mixing | | | |
| Induction Time | | | |
| Pot Time | | | |
| Thinning, type and amount | | | |
| Equipment Used | | | |
| air pressure (psi) | | | |
| fluid pressure (psi) | | | |
| atomization pressure | | | |
| nozzle/tip size | | | |
| brush or roller type | | | |
| Date Applied | | | |
| Time Applied | | | |
| Time Between Coats | | | |
| Cumulative Dry Film Thickness (DFT), mils or micrometers | | | |
| Appearance Defects | | | |

| | | | |
|---|---|---|---|
| Samples Taken: | Abrasive: | Replica Tape: | Coatings: |
| Method of Scribe | | | |
| Photographs (record details of time, place and situation for each photo taken) | Original Condition | Operations | Completed Test Areas |

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-Guide 10
August 1, 1994
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# GUIDE 10

## Guide to Specifying Coatings Conforming to Volatile Organic Compound (VOC) Content Requirements

### 1. Scope

**1.1** This guide describes procedures for preparing a specification for protective coatings conforming with volatile organic compound (VOC) content requirements.

**1.2** Procedures cover determining VOC content, compliance requirements, qualifying, selecting, and evaluating performance of coatings, and assembling the specification.

**1.3** This guide is intended to be used by specifiers, end users, and others who are required to select, test, or specify coatings to meet VOC regulations.

### 2. Description and Definitions

**2.1** This guide describes the major steps needed to prepare a specification to comply with VOC regulations.

**2.1.1 Understanding VOC Regulations (Section 4):** This section describes the basis of regulations and how VOCs are regulated. The types of regulations and the various coating categories are outlined.

**2.1.2 Determining VOC Requirements (Section 5):** Specific procedures include determining location of the coating application, identifying the agency having jurisdiction, determining the category of coating, determining the VOC level that must be met, and selecting the test method for determining VOC content.

**2.1.3 Selecting Coatings to Meet VOC Requirements (Section 6):** This section establishes the requirements for qualifying and selecting coatings to meet VOC requirements. Requirements include coating performance properties, application properties, field case histories, and supplier service. For each set of requirements the guide describes approaches for developing specific criteria and rating schemes.

**2.1.4 Preparing Specifications (Section 7):** This section gives guidance on assembling the specification. Key components include performance and application requirements, supplier qualification, VOC classification, thinning, and quality control provisions.

**2.1.5 State Contacts for Air Quality Control Regulations (Appendix A):** Information is also provided on state air quality contacts.

**2.2 VOC LEVELS:** Coatings are typically regulated by establishing limits on the VOC content of the coating at the time of application after addition of any thinners. (See Note 9.1)

This guide identifies six possible levels of VOC content which might be adopted for various coating categories:

- VOC Level 1 - less than or equal to 60 9/L (0.5 lbs/ gal)
- VOC Level 2 - less than or equal to 120 g/liter (1.0 lbs/ gal)
- VOC Level 3 - less than or equal to 250 g/liter (2.1 lbs/ gal)
- VOC Level 4 - less than or equal to 340 g/liter (2.8 lbs/ gal)
- VOC Level 5 - less than or equal to 420 g/liter (3.5 lbs/ gal)
- VOC Level 6 - unrestricted VOC content

(Editor's Note: As of the Eighth Edition of Volume 2 [September, 2000], these categories are no longer used in SSPC standards for paints and painting systems.)

**2.3 DEFINITIONS**

**2.3.1 Volatile Organic Compound (VOC)**

**2.3.1.1 ASTM D 3960: Volatile Organic Compound (VOC):** In coatings, any compound of carbon that evaporates from a paint or coating film under specific test conditions is a VOC. It thus does not include water and exempt solvents that are volatile. VOC may be determined at a specified temperature for a specified baking or air dry time and at a controlled film thickness.

**2.3.1.2 U.S. Environmental Protection Agency Reference Method 24 - Volatile Organic Compound (VOC):** Any organic compound which participates in atmospheric photochemical reactions is a VOC; that is, any organic compound other than those which the administrator designates as having negligible photochemical reactivity (known as “exempt solvents;” see Note 9.2). VOCs may be measured by a reference method, an equivalent method, an alternative method or by procedures specified under any subpart.

**2.3.2 Transfer Efficiency:** The ratio of the mass or volume of coatings solids adhering to an object to the total

Provided by : www.spic.ir Licensee: NISOC Library

mass or volume, respectively, of coating solids used in the application process, expressed as a percentage. (See Note 9.3.)

**2.3.3 Attainment Area:** An area considered to have air quality as good as or better than the national ambient air quality standards as defined in the Clean Air Act. An area may be an attainment area for one pollutant and a non-attainment area for others. For ozone, attainment requires that the ozone concentration not exceed 0.12 ppm (as a one-hour weighted average) more than once a year for three consecutive years.

**2.3.4 Control Technique Guidelines (CTG):** A series of EPA documents designed to assist states in defining Reasonable Available Control Technology (RACT) for major sources of volatile organic compounds.

**2.3.5 State Implementation Plans (SIP):** EPA-approved state plans for the establishment, regulation, and enforcement of air pollution standards.

**2.3.6 Material Safety Data Sheet (MSDS):** A compilation of information required under the OSHA Hazard Communication Standard on the identity of hazardous chemicals, health and physical hazards, exposure limits, and precautions. Section 311 of SARA requires facilities to submit an MSDS under certain circumstances.

## 3. References

**3.1** The standards and statutes referenced in this guide are listed in Sections 3.3 through 3.6.

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

**3.3 SSPC STANDARDS:**

**Guide 9** Guide for Atmospheric Testing of Coatings in the Field

**3.4 AMERICAN SOCIETY FOR TESTING & MATERIALS (ASTM) STANDARDS:**

**D 610** Standard Method for Evaluating Degree of Rusting on Painted Steel Surfaces

**D 1640** Standard Test Method for Drying Times of Organic Coatings at Room Temperature

**D 3960-89** Standard Practice for Determining Volatile Organic Content of Paints and Related Coatings.

**3.5 U.S. ENVIRONMENTAL PROTECTION AGENCY METHOD:**

**40 CFR Ch. 1, Part 60, Appendix A, Method 24**
Determination of Volatile Matter Content, Water Content, Density, Volume Solids and Weight Solids of Surface Coatings

**3.6 ENVIRONMENTAL STATUTES:**
Clean Air Act, 1970
Clean Air Act Amendments, 1977 and 1990
Superfund Amendment and Reauthorization Act (SARA), 1986

## 4. Understanding VOC Regulations

### 4.1 REGULATING VOCS

**4.1.1 Basis of Regulation:** EPA and other environmental agencies regulate the VOC emission of coatings because VOCs are a precursor to ozone (a component of smog, the adverse effects of which have been extensively demonstrated). EPA was authorized by Congress through the Clean Air Act of 1970 and the Clean Air Act Amendments of 1977 and 1990 to coordinate and guide the state efforts to assure that all citizens have air of acceptable quality. To that end Federal and State agencies are developing regulations to control the production of ozone producing VOCs.

**4.1.2 How VOCS Are Regulated**

**a. VOC Content:** The most common method for regulating VOCs is by the mass of VOC emitted per volume of liquid coating less water and exempt solvents (see 2.3.1.2 and Note 9.2). Typical units are grams of VOC per liter (g/L) of coating or pounds of VOC per gallon of coating (lb/gal) (see Note 9.2.1). As described in Section 2.3.1, it is necessary to subtract the volume of water or of exempt solvents from the overall coating volume before computing VOC content. (Note: The “less water and exempt solvent” phrase has been omitted hereafter, but it should be understood to be an integral part of all subsequent quantitative terms.)

Commonly specified VOC levels are 420 g/L (3.5 lb/gal), 340 g/L (2.8 lb/gal), and 250 g/L (2.1 lb/gal). These are defined as SSPC VOC Levels 5, 4, and 3, respectively. Other levels established by SSPC include: Level 1 - less than or equal to 60 g/L (0.5 lb/gal), Level 2 - less than or equal to 120 g/L (1.0 lbs/gal), and Level 6 - unrestricted VOC content. These levels have been established to encourage uniformity throughout the industry in regulation of VOCs and product development efforts. Other levels (such as 350 g/L [2.92 lbs/gal] or 380 g/L [3.17 lbs/gal]) have also been used by various regulatory agencies.

Provided by : www.spic.ir Licensee: NISOC Library

**b. Total VOCs Emitted:** Some agencies set limits on the total weight of VOCs that can be emitted from a plant or facility in a day or year (kilograms or pounds). This type of rule has been applied for regulating VOC content for miscellaneous metal parts. (See 4.3.1.)

**c. Transfer Efficiency:** Transfer efficiency is defined in Section 2.3.2 (see also Note 9.3). A few agencies have imposed a minimum transfer efficiency (e.g., 65%) for the application of a coating to a substrate. Any reduction in the amount of coating wasted will of necessity reduce the amount of VOC emitted into the atmosphere. There is no direct correlation between transfer efficiency and VOC content of coatings, as a high VOC coating can be applied with high transfer efficiency or low transfer efficiency.

### 4.2 TYPES OF REGULATIONS

**4.2.1 EPA Control Technique Guidelines:** Control Technique Guidelines (CTGs) are documents prepared by EPA which establish the level of control deemed to represent "Reasonably Available Control Technology." Publication of a CTG triggers a requirement that the states develop a state rule for major industries of the type for which the CTG was written. In many cases, states promulgated the recommendation in the CTG. In other cases, states developed different rules. Typically, a state is required to develop a State Implementation Plan (SIP) describing the methods to achieve the guidelines and the means to verify compliance. Another important feature of a CTG is that it is only applicable to those areas which are designated by EPA as non-attainment for ozone. The definition of attainment for ozone is given in 2.3.3.

**4.2.2 EPA National Rule:** A National Rule establishes a national requirement for controlling VOCs (i.e., by setting a standard level of compliance for total amount of VOC emitted, or limitations of VOC content of a coating). Unlike the CTG, a National Rule applies to all areas of the U.S. National Rules may be preemptive or non-preemptive. Preemptive rules prevent any air quality district (e.g., state, county, district) from having a rule more restrictive than the Federal rule. In a non-preemptive rule, individual states or air quality districts are permitted to have more stringent rules. Any local rule must be at least as stringent as the National Rule. To date, EPA has not issued any National Rules regarding protective coatings for structures.

**4.2.3 State and Local Regulations:** Most states have environmental agencies charged with protecting air quality. In many cases, they issue statewide regulations to meet EPA CTGs. However, because the CTGs do not mandate specific VOC levels or total emissions, the states are required to develop their own approaches to controlling VOCs from different surface coating operations. Many states have designated air quality districts based on geographical factors or population distributions. Thus, areas with higher potential for air pollution will tend to have stricter regulations regarding VOCs and other ozone-producing activities. For example, California has established approximately 30 air quality districts, each of which has authority to regulate the VOC content of coatings. Also, most large metropolitan areas (e.g., New York area, Chicago area) have air quality jurisdictions which may overlap cities, counties, or states. Any facility or structure owner requiring surface coating must be aware of the jurisdictions within which the coating application (and hence the VOC emissions) will occur.

**4.3 COATING CATEGORIES:** EPA has established a variety of categories for coatings typically used for heavy-duty industrial maintenance and new construction and architectural coating applications. The principal ones are as follows:

**4.3.1. Miscellaneous Metal Parts and Products:** This category includes coatings applied to various factory finished metals, including fabricated metal structures. Typical applications include shop-applied primers for bridges, water towers, and other steel structures, and coatings applied in railcar shops.

Typically, these rules are based on a CTG issued in 1978 by EPA as a guidance document for areas that have been designated as exceeding the national ambient air quality standard (NAAQS) for ozone. Coatings are classified as follows, with their recommended VOC limits:

- Air-dried coatings: 3.5 lbs/gal (420 g/L) - dried by the use of air or forced warm air at temperatures up to 194 ˚F (90 ˚C).
- Clear coatings: 4.3 lbs/gal (520 g/L) - unpigmented or transparent coating lacking color and opacity.
- Extreme performance coatings: 3.5 lbs/gal (420 g/L) - designed for harsh exposure or extreme environmental conditions.
- All other coatings: 3.0 lbs/gal (360 g/L) - any other type of coating.

**4.3.2 Marine Coatings:** These are coatings applied to ships, boats, and their appurtenances, and to buoys and oil drilling rigs intended for the marine environment. (See Note 9.2.2.)

**4.3.3 Architectural and Industrial Maintenance (AIM) Coatings:** This category, which is often referred to as Architectural Coatings, is a broad category encompassing most field-applied coatings for residential, commercial, or industrial applications. It also includes pavement marking coatings. Because of this diversity, it is useful to subdivide

Provided by : www.spic.ir Licensee: NISOC Library

this category as follows:

**a. Architectural Coatings:** These are coatings applied to exteriors and interiors of residential and commercial structures, including houses, warehouses, commercial buildings, stadiums, hospitals, and schools. Coatings are intended to provide good appearance properties and to protect against wear and weather in normal indoor and outdoor environments. (See Note 9.2.3.)

**b. Industrial Maintenance:** These are coatings applied to steel and concrete industrial facilities or structures. The coatings are intended to provide long-term protection against corrosion and weathering in exposures ranging from mild to severe atmospheric, salt or potable water immersion, intermittent or continual immersion in chemicals or solvents, abrasive conditions, and extremes of pH, temperature, and pressure. (See Section 9.4 for a definition from the California Air Resources Board.)

## 5. Determining VOC Requirements

**5.1. DETERMINE LOCATION OF PAINT APPLICATION:** Identify the location or locations where paint will be applied, as the VOC content permitted depends on the site of application. Be sure to include both shop and field painting.

**5.2 IDENTIFY THE AGENCY HAVING JURISDICTION:** For each location where paint will be applied, determine the agency which has jurisdiction over air quality regulations. The jurisdiction may be a state, county, city, or air quality district. A list of state air quality contacts is attached as Appendix A. This information is regularly updated by the Air and Waste Management Association.

**5.3 DETERMINE CATEGORY OF COATING:** Select the coating category based on the descriptions in Section 4.3. If there is some question about the classification, contact the appropriate air quality district officials.

**5.4 DETERMINE VOC LEVEL THAT MUST BE MET:** Obtain a copy of the specific regulations for the category of coatings and for the air quality jurisdiction. Please note the following points: estimated volume of coating to be applied, limitations on total VOC emissions, limitations on VOCs for coating, test methods (see also 5.5 and Note 9.5), and specific definitions regarding generic types or conditions (e.g., temperature or composition). Prepare a written list of all the regulations and provisions that must be met prior to selecting or applying a coating.

**5.5 SELECTION OF THE TEST METHOD FOR DETERMINING VOCS:** After identifying the VOC compliance requirements outlined in Sec. 5.4, determine if the regulatory agency has referenced a specified method for testing. If so, that method shall be used. If no test method is specified, EPA Method 24 shall be used. (See Note 9.5 for alternate methods.)

Although a calculation based on formulation may be used to estimate VOC, compliance penalties will be based on VOC as measured by the referenced analytical method. Measurements and calculations should be based on the level of VOC of the coating as applied in the field after thinning.

## 6. Selecting Coatings to Meet VOC Requirements

**6.1 GENERAL APPROACH:** Because many currently used coatings do not meet current or proposed VOC requirements, there is a need to establish a program to select coatings that meet these requirements. A program for accomplishing this would be similar to any other program used to select coatings and should start with establishment of selection criteria. One criterion would be that the coatings meet the required VOC levels. Normally it is necessary that each coating in a coating system (primer, intermediate, and topcoat) not exceed the maximum VOC content permissible.

**6.2 ESTABLISH SELECTION CRITERIA TO BE USED**

**6.2.1** Listed below are criteria that can be used to qualify VOC-compliant coatings. Select the criteria to be used for the specification. For each one selected, follow the guidelines in the appropriate sections that follow.

- Laboratory and short-term field performance (Section 6.3).
- Application properties (Section 6.4).
- Case histories (Section 6.5).
- Availability and quality of supplier service (Section 6.6).

If a formal numerical evaluation will be conducted, identify the relative weighting factors for the various criteria. Also determine if the comparisons will be relative (i.e., select the top 1, 2, or 3) or absolute (i.e., establish a level in advance which all qualified coatings or suppliers must meet). Prepared detailed criteria based on Sections 6.3 through 6.6.

**6.3 DEVELOP CRITERIA FOR PERFORMANCE TESTS**

**6.3.1 Identify Specific Laboratory Performance Tests:** The industry has developed a wide range of different types of performance tests for protective coating systems, depending on the intended service and other requirements and the time and resources available to conduct the testing. Among the most widely used performance tests are the following:

Provided by : www.spic.ir Licensee: NISOC Library

- Accelerated Laboratory Aging and Corrosion Tests: These include humidity testing, salt fog testing, cyclic salt spray, and immersion.
- Accelerated Weathering Testing: These include exposure to fluorescent UV, carbon and xenon arcs, and cycling of the exposures with humidity condensation or water spray.
- Physical Tests: These include hardness, abrasion resistance, and flexibility.
- Chemical Tests: Coating specimens are immersed in chemical solutions or the chemicals are applied to small spots on the coating to determine resistance.
- Short-Term Test Fence Exposures: Coating systems are applied to metal or other panels and placed on an outdoor rack or fence and evaluated periodically for up to one or two years for rusting, blistering, or loss of gloss or color (see SSPC-Guide 9).

**6.3.2 Provide Details on Conducting Performance Tests:** These include the generic types of coatings to be tested, level of VOC sought, test methods to be used (including ASTM standard numbers where available), number of test specimens, method of preparation and application, duration of test, and methods of evaluating and rating specimens. Also identify the types of control coatings. These are coatings that are to be used as reference coatings based on their past performance or their common acceptance as industry standards. These may not necessarily meet the VOC requirements.

**6.3.3 Determine Who Will Perform the Testing:** This may be done by facility owner/specifier, paint supplier, or independent testing laboratory.

**6.3.4 Select Candidate Coatings:** Prepare a list of required VOC-compliant coatings. The following information should be furnished:

- Maximum VOC content acceptable.
- Service environments.
- Types of generic coating systems currently used in these environments. Note: It is often advantageous to give the supplier the choice of a generic system. Conventional systems formulated at high VOC levels may not be available or may give reduced performance at reduced VOC levels.
- Identify other restrictions or conditions (e.g., lead- and chromate-free, limitations on blast cleaning or other surface preparation, other material restrictions, drying, curing or other application require ments).
- Quantity required and date of delivery.

Supplier should be required to furnish current Material Safety Data Sheets (MSDS), Technical Data Sheets, and application instructions for each coating furnished. (See Note 9.6.)

**6.3.5 Implement Testing Program:** Conduct or direct testing in accordance with Section 6.3.1 to 6.3.4 above. If test is to be run by a supplier, consider requiring written certification of the test results, as well as copies of raw data.

**6.3.6 Evaluate Test Results:** Determine relative rating or ranking and whether the coatings have met the designated performance criteria.

**6.4 DEVELOP CRITERIA FOR APPLICATION PROPERTIES**

**6.4.1 Identify Specific Requirements for Coating Application Properties:** Coatings to be applied to structures (particularly field applications) must be capable of being applied under the various weather and other conditions that may occur. Coating application tests that can be incorporated into a program include:

- Application by various types of equipment, including brush, roller, airless spray, air spray, or new specialized techniques.
- Tolerance to film thickness range. One cannot assume that in the field the coating will be applied at precisely the DFT recommended by the manufacturer. More realistically, lower or higher DFTs may be encountered.
- Ability to wet and penetrate different substrates and configurations. Coatings must be able to flow out and level under a variety of geometries and over substrates cleaned to different degrees and contaminated with salts, old paint, or rust.
- Tolerance to weather conditions. Coatings are often applied in conditions of moderate wind (up to 10 mph [16 km/hr]) and at the extremes of humidity and temperature limitations imposed by the manufacturer (50 to 90˚F [10 to 31˚C] and up to 85% relative humidity).

**6.4.2 Evaluate Coating Application Properties**

- Determine who will perform the testing. This can be the owner, the supplier, a painting contractor, or an independent laboratory.
- Select application equipment which will be comparable to that used in the production application.
- Select structural configuration. The coating system should be applied to a minimum of 46 square feet on a structure representative of that to be coated under the expected application conditions (see SSPC-Guide 9). Evaluate the application based on criteria such as absence of runs, sags, dry spray, and voids.

Provided by : www.spic.ir Licensee: NISOC Library

- Determine time for coating to dry to touch and to dry hard in accordance with ASTM D 1640.
- Verify that coating is properly cured based on standard procedures.
- Determine if coating has met application criteria.

### 6.5 DEVELOP CRITERIA FOR CASE HISTORIES

**6.5.1 Significance:** Case histories can often provide insight into the practical aspects of a coatings performance and identify special precautions or problems that have been encountered in production applications. The value depends on how closely the conditions (i.e., structure and exposure) match the intended use. Also of significance are the duration of the case history, the validity of the ratings, and the quality of the documentation of performance.

**6.5.2 Document Case History:** The following information should be sought:

- Identification of structure, including location, owner type, size, and configuration.
- Exposure environment, including the presence of salts, sulfur dioxide, or other contaminants, as well as the typical humidity, rainfall, and other aggressive conditions.
- Condition of structure prior to coating application (the amount of rust, deteriorated paint, pitting, or other conditions prior to surface preparation as well as the degree of cleaning that has been achieved).
- Coating system applied. Information should include the method of surface preparation, surface profile achieved (if blast cleaned), dry film thickness (including ranges and averages), and method of application.
- Dates of application and inspection.
- Control (reference coatings) used, if any.
- Criteria for evaluating condition (e.g. rusting, undercutting) as well as the specific standards utilized (e.g., ASTM D 610/SSPC-VIS 2).
- Name and phone number of the facility owner's representative and the painting contractor or applicator.

**6.5.3 Evaluate Case History**

- The duration of exposure should be rated as follows:

  Inadequate - less than 18 months
  Adequate - 24 months
  Superior - greater than three to five years
- Evaluate the validity of the ratings based on the source of the ratings and the extent of documentation as follows: Inadequate, Adequate, Superior.
- Determine the similarity of the case history to the proposed application as follows: Inadequate, Adequate, Superior.
- Provide an overall case history rating as Inadequate, Adequate, or Superior.

### 6.6 DEVELOP CRITERIA FOR SUPPLIER SERVICE

**6.6.1 Significance:** Successful field application of coatings is not achieved automatically, but rather requires cooperation among the coating supplier, the facility owner, and the applicator. The supplier should provide accurate information on technical and application properties and on safety or health hazards, as well as advice on correcting application or problems.

**6.6.2 Availability of Materials:** It is important that the coating supplier be able to furnish the quantity of coating required to the facility being coated in a timely manner. Some coatings may be in limited production or may require shipping from another region. These factors could affect the cost as well as the timing of delivery.

**6.6.3 Document Past Service:** Identify specific jobs or experience with the supplier. If the facility owner has not had specific experience, it may be possible to contact other owners in the vicinity. Other information may be obtained from reputable contractors who have utilized the company's products or services. A qualitative rating scheme may be established for the qualifications of technical and other service provided by the coatings supplier as follows: Inadequate, Adequate, Superior.

Specific information sought is as follows:

- Accuracy, clarity and completeness of technical and application data sheets and MSDS.
- Promptness and quality of response to requests for information.
- Presence and availability of technical or sales representative at major jobs or where problems have arisen.
- Overall strength of product line, i.e., whether this company can meet the majority of the coating materials requirements for the various types of applications required.
- Product availability and timeliness of delivery.
- Rate each of the above items as Inadequate, Adequate, or Superior. At a minimum, the supplier should receive an overall rating of Adequate.

**6.7 OVERALL RATING:** Prepare a consolidated list of the criteria and results of the evaluation for each of the criteria selected. Rank the different coatings selected from best to worst, and if possible, identify a minimally acceptable set of coating materials for inclusion in the specification.

Provided by : www.spic.ir Licensee: NISOC Library

## 7. Prepare Specification for VOC-Compliant Coatings

Specifications must be written for coatings or coating systems that meet the performance requirements of the intended service and other criteria described in Section 6. They must also meet the VOC requirements determined in Section 5.

**7.1 PERFORMANCE AND APPLICATION REQUIREMENTS:** Incorporate the criteria for the performance and application tests and case histories from Sections 6.3, 6.4, and 6.5 into this portion of the specification.

**7.2 SUPPLIER QUALIFICATIONS:** Incorporate the requirements of Section 6.6 into this portion of the specification if the facility owner intends to evaluate suppliers.

**7.3 VOC CLASSIFICATION:** Incorporate in the specification the VOC class or other VOC requirements for the jurisdiction. The VOC classes are listed in Section 2.2. Also include the test method for measuring VOC from Section 5.5.

**7.4 THINNING RESTRICTIONS:** The specification should require that the coating shall not be thinned in the field beyond the level given in the coating supplier's written technical data sheets. The data sheet should indicate the VOC content of the coating after maximum thinning.

**7.5 QUALITY CONTROL PROVISION:** The specification should require that the coating supplied will have met the requirements of Section 6. Examples of tests to verify the composition of coatings are as follows: viscosity, density, infrared spectrum of vehicle (binder and solvent), fineness of dispersion, percent solids by weight or volume, and color. If required by owner, request a letter from the supplier certifying the above, and identify the specific test conditions.

## 8. Disclaimer

While every precaution is taken to ensure that all information furnished in SSPC specifications is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, paints or methods specified therein, or of the specification itself.

## 9. Notes

9.1 EPA has traditionally expressed limitations on allowable VOC emissions from factory-applied coatings in terms of the maximum "VOC content" of a coating. By expressing the limitations in terms of the allowable VOC content of the coating, the Agency's intent was to spur pollution prevention efforts on the part of paint and resin manufacturers as they attempted to develop coatings that could comply without the need for their customers to invest in abatement equipment. As the Agency follows the instructions of Congress to limit emissions from field- applied coatings, the abatement option will frequently not be a realistic option and lower VOC coatings will be the only practical avenue for compliance. One regulatory possibility would exclude from commerce any coating after addition of thinners that exceeded some specific predetermined VOC content.

**9.2** A reference method, an equivalent method, or an alternative method, however, may also measure nonreactive organic compounds. In such cases, an owner or operator may exclude the nonreactive compounds when determining compliance with a standard. The EPA administrator has designated the following organic compounds as negligibly reactive: methane, ethane, 1,1,1-trichloroethane (methyl chloroform), methylene chloride (dichloromethane), trichlorofluoromethane (CFC-11), dichlorodifluoromethane (CFC-12), chlorodifluoromethane (CFC-22), trifluoromethane (CFC-23), trichlorotrifluororethane (CFC-113), dichlorotetrafluoroethane (CFC-114), and chloropentafluoroethane (CFC-15).

**9.2.1** At least one state (Texas) computes VOC on the basis of mass (wt) of solvent per volume of solid coating applied to the surface.

**9.2.2** This definition of marine coatings is derived from Rule 1106, "Marine Coating Operations" from the South Coast Air Quality Management District.

**9.2.3** Sometimes an additional subset of "high-performance architectural coatings" is defined, which includes commercial structures intended to give long-term protection in normal or aggressive environments.

**9.3. TRANSFER EFFICIENCY**

Transfer efficiency (defined in Section 2.3.2) is a measure of the proportion of the mass or volume of coating solids adhering to an object.

$$\text{Transfer Efficiency (\%)} = \frac{\text{Mass of solid coating on item} \times 100}{\text{Mass of solid coating consumed}}$$

OR

$$\text{Transfer Efficiency (\%)} = \frac{\text{Volume of solid coating on item} \times 100}{\text{Volume of solid coating consumed}}$$

Factors that most affect paint transfer efficiency are:

- Item size and shape
- Type of application equipment



Provided by : www.spic.ir Licensee: NISOC Library

- Distance of spray gun from item
- Spray gun pressure
- Wind speed and direction

The smaller and more complex the item, the lower the transfer efficiency. The greater the distance of spray gun from item and the greater the atomizing pressures, usually the lower the transfer efficiency. The relative order of transfer efficiencies of different types of application equipment, from high to low, is:

- Manual (brush or roller)
- Electrostatic spray
- High-volume, low-pressure spray
- Air-assisted airless spray
- Airless spray
- Conventional air spray

**9.4** The following definition of Industrial Maintenance Coatings has been prepared by ARB-CAPCAA, California Air Resources Board.

Industrial Maintenance Coatings: High-performance architectural coatings formulated for and applied to substrates that are exposed to one or more of the following extreme environmental conditions:

a. Immersion in water, wastewater, or chemical solutions (aqueous and non-aqueous solutions), or chronic exposure of interior surfaces to moisture condensation.

b. Acute or chronic exposure to corrosive, caustic, or acidic agents, or to chemicals, chemical fumes, chemical mixtures, solutions, or salt spray.

c. Repeated exposure to temperatures in excess of 200˚F.

d. Repeated heavy abrasion, including mechanical wear and repeated scrubbing with industrial solvents, cleansers, or scouring agents.

e. Exterior exposure of metal surfaces.

**9.5** The methods in 3.4 and 3.5 may not be applicable for testing for VOCs in all jurisdictions. It will be necessary for the specifier, end user, or others to verify whether these methods are applicable in the area that the coating is to be used. Other methods are described in more detail in "VOC Test Methods for Surface Coatings," by Christine Stanley (Journal of Protective Coatings and Linings, Vol. 7, No. 7, July 1990, pp. 20-24).

**9.5.1** Bay Area Air Quality Management District (BAAQMD) Method 21 and 22 (water based and solvent based coatings).

**9.5.2** South Coast Air Quality Management District (SCAQMD), Rule 107.

**9.6** The MSDS is required under OSHA Hazard Communications Standard 29 CFR 1926.59.

## APPENDIX A. STATE CONTACTS FOR AIR QUALITY CONTROL REGULATIONS

**Alabama**
Alabama Dept. of Environmental Management
1751 Congressman William L. Dickinson Drive
Montgomery, AL 36130
205-271 -7861

**Alaska**
Alaska Dept. of Environmental Conservation
410 Willoughby Ave., Room 105
Juneau, AK 99801-1795
907-465-5100

**Arizona**
Office of Air Quality
Arizona Dept. of Environmental Quality
P.O. Box 600
Phoenix, AZ 85001-0600
602-207-2308

**Arkansas**
Arkansas Dept. of Pollution Control and Ecology
8001 National Drive
Little Rock, AR 72209
501-562-7444

**California**
California Air Resources Board
2020 "L" Street
Sacramento, CA 95814
916-322-2990

**Colorado**
Colorado Dept. of Health. Air Pollution Control Division
4300 Cherry Creek Drive
Denver, CO 80220-1530
303-692-3100

**Connecticut**
Air Management Bureau
79 Elm Street
Hartford, CT 06106-5127
203-566-2690

**Delaware**
Department of Natural Resources and Environmental Control
Division of Air and Waste Management
89 Kings Highway
P.O. Box 1401
Dover, DE 19903
302-739-4764

Provided by : www.spic.ir Licensee: NISOC Library

**District of Columbia**
Air Resources Management Division
2100 Martin Luther King Ave., SE
Washington, DC 20020
202-404-1180

**Florida**
Florida Dept. of Environmental Protection
2600 Blair Stone Road
Twin Towers Office Building
Tallahassee, FL 32399-2400
904-488-0114

**Georgia**
Georgia Air Protection Branch
4244 International Parkway
Suite 120
Atlanta, GA 30354
404-363-7000

**Guam**
Guam Environmental Protection Agency
IT&E Harmon Plaza
Complex Unit D-107
130 Rojas Street
Harmon, Guam 96911
671-646-8863

**Hawaii**
Clean Air Branch
P.O. Box 3378
Honolulu, HI 96801
808-5864200

**Idaho**
Idaho Dept. of Health And Welfare
Division of Environmental Quality
1410 N. Hilton Street
Boise, ID 83706
208-334-0502

**Illinois**
Illinois Environmental Protection Agency
Division of Air Pollution Control
2200 Churchill Road
P.O. Box 19276
Springfield, IL 62794-9276
217-782-7326

**Indiana**
Indiana Dept. of Environmental Management
100 North Senate Ave.
ICON, 10th Floor
P.O. Box 6015
Indianapolis, IN 46206-6015
317-232-3210

**Iowa**
Iowa Dept. of Natural Resources
Henry A. Wallace Bldg.
Des Moines, IA 50319
515-281-5145

**Kansas**
Bureau of Air and Radiation
Forbes Field, Building 740
Topeka, KS 66620
913-296-1593

**Kentucky**
Division for Air Quality
Dept. for Environmental Protection
316 St. Clair Mall
Frankfort, KY 40601
502-564-3382

**Louisiana**
Dept. of Environmental Quality
Office of Air Quality and Radiation Protection
7290 Bluebonnet
Baton Rouge, LA 70810
504-765-0219

**Maine**
Bureau of Air Quality Control
Dept. of Environmental Protection
State House, Station 17
Augusta, ME 04333
207-289-2437

**Maryland**
Air & Radiation Management Admin.
2500 Broening Highway
Baltimore, MD 21224
410-631-3255

**Massachusetts**
Division of Air Quality Control
One Winter Street
Boston, MA 02108
617-292-5593

**Michigan**
Air Quality Division
Michigan Dept. of Natural Resources
P.O. Box 30028
Lansing, MI 48909
517-373-7023

Provided by : www.spic.ir Licensee: NISOC Library

**Minnesota**
Air Pollution Control
Minnesota Pollution Control Agency
520 Lafayette Road
St. Paul, MN 55155
612-296-7331

**Mississippi**
Mississippi Dept. of Environmental Quality
2380 Highway 80 West
Jackson, MS 39204
601-961-5171

**Missouri**
Missouri Dept. of Natural Resources
Air Pollution Control Program
205 Jefferson
Jefferson City, MO 65102
314-751-4817

**Montana**
Montana State Dept. of Health and Environmental Sciences
Air Quality Bureau
P.O. Box 200901
Helena, MT 59620-0901
406-444-3454

**Nebraska**
Air Quality Program
Nebraska Dept. of Environmental Quality
1200 N Street, Suite 400
P.O. Box 98922
Lincoln, NE 68509
402-471-2189

**Nevada**
Bureau of Air Quality Division of Environmental Protection
333 West Nye Lane
Carson City, NV 89710
702-687-4670

**New Hampshire**
Dept. of Environmental Services
Air Resources Division
64 N. Main St.
Caller Box 2033
Concord, NH 03302-2033
603-271-1370

**New Jersey**
New Jersey State Dept. of Environmental Protection and Energy
Air Pollution Control Program
401 East State Street, CN027
Trenton, NJ 08625
609-292-6704

**New Mexico**
Environment Dept.
Air Quality Bureau
1190 St. Francis Drive
Santa Fe, NM 87502
505-827-2850

**New York**
New York Dept. of Environmental Conservation
Division of Air Resources
50 Wolf Road
Albany, NY 12223-3250
518-457-7230

**North Carolina**
Division of Environmental Management
P.O. Box 29535
Raleigh, NC 27626-0535
919-733-3340

**North Dakota**
North Dakota State Dept. of Health
1200 Missouri Ave.
Bismarck, ND 58502-5520
701-221-5188

**Ohio**
Ohio Environmental Protection Agency
1800 WaterMark Drive
Columbus, OH 43266-0149
614-644-2270

**Oklahoma**
Oklahoma Dept. of Environmental Quality
Air Quality Division
4545 N. Lincoln, Ste. 250
Oklahoma City, OK 73105-3483
405-271-7508

**Oregon**
Air Quality Division
Oregon Dept. of Environmental Quality
811 SW 6th Ave.
11th Floor
Portland, OR 97204
503-229-5359

**Pennsylvania**
Dept. of Environmental Resources
Bureau of Air Quality Control
400 Market Street

Provided by : www.spic.ir Licensee: NISOC Library

P.O. Box 8468
Harrisburg, PA 17105-8468
717-787-9702

**Puerto Rico**
Puerto Rico Environmental Quality Board
Ponce de Leon Ave., #431
Puerto Rico, 00906
809-767-8071

**Rhode Island**
Rhode Island Division of Air and Hazardous Materials
291 Promenade Street
Providence, RI 02908-5767
401-277-2808

**South Carolina**
South Carolina Dept. of Health and Environmental Control
Bureau of Air Quality
2600 Bull Street
Columbia, SC 29201
803-734-4750

**South Dakota**
Dept. of Environmental and Natural Resources
Division of Environmental Regulation
523 E. Capitol Ave.
Pierre, SD 57501
605-773-3351

**Tennessee**
Tennessee Division of Air Pollution Control
Customs House
401 Church St., 9th Floor
L&C Annex
Nashville, TN 37243-1531
615-532-0554

**Texas**
Texas Air Control Board
6330 Highway 290 East
Austin, TX 78723
512-451-5711

**Utah**
Division of Air Quality
State of Utah
Dept. of Environmental Quality
150 North 1950 West
P.O. Box 144820
Salt Lake City, UT 84114-4820
801-536-4000

**Vermont**
Air Pollution Control Division
Agency of Natural Resources
103 S. Main Street
Waterbury, VT 05671-0402
802-244-8731

**Virgin Islands**
Dept. of Planning & Natural Resources
Division of Environmental Protection
Water Gut Homes
1118 C'stead Stx.
U.S. VI, 00820-5065
809-773-0565

**Virginia**
Dept. of Air Pollution Control
P.O. Box 10089
Richmond, VA 23240
804-786-2378

**Washington**
Washington State Dept. of Ecology
P.O. Box 47600
Olympia. WA 98504-7600
206-459-6256

**West Virginia**
West Virginia Air Pollution Control Commission
1558 Washington Street, East
Charleston, WV 25311
304-348-4022

**Wisconsin**
Wisconsin Dept. of Natural Resources
Bureau of Air Management
Box 7921
Madison. WI 53707
608-266-7718

**Wyoming**
Air Quality Division
Dept. of Environmental Quality
122 W. 25th Street
Cheyenne, WY 82002
307-777-7391

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC: The Society for Protective Coatings

# GUIDE NO. 11

## Guide for Coating Concrete

## 1. Scope

**1.1** This Guide describes basic procedures for surface preparation and application of coatings to concrete surfaces in industrial plants or commercial facilities.

**1.2** The Guide is pertinent for both new construction and maintenance applications.

**1.3** This Guide is intended for use by the owner's representatives and applicators.

## 2. Description and Definitions

### 2.1 DESCRIPTION

**2.1.1** Coatings are applied to concrete surfaces to prevent degradation, to maintain appearance and to preserve purity of product contained within a concrete structure.

**2.1.2** The major procedures covered in the Guide are surface preparation, coating application, inspection, and safety.

### 2.2 DEFINITIONS

**2.2.1 Bug Holes:** Small regular or irregular cavities, usually not exceeding 15 mm in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and consolidation.

**2.2.2 Concrete:** A composite material that consists essentially of a binding medium within which are embedded particles or fragments of aggregate, usually a combination of fine aggregate and coarse aggregate.

**2.2.3 Curing Membrane:** Materials applied to prevent the moisture in uncured concrete from evaporating too rapidly.

**2.2.4 Efflorescence:** A white crystalline or powdery deposit on the surface of concrete. Efflorescence results from leaching of lime or calcium hydroxide out of a permeable concrete mass over time by water, followed by reaction with carbon dioxide and acidic pollutants.

**2.2.5 Form Release Agents:** Compounds such as petroleum oils, waxes, and silicones applied to forms to allow easy removal of forms.

**2.2.6 Hydration:** The reaction of water with the calcium silicate, aluminate or aluminoferrite components of fine cement grains, necessary for the setting and densifying of concrete. Hydration results in the formation of calcium hydroxide and colloidal gels which occupy a larger volume than the original cement.

**2.2.7 Hydrostatic Pressure:** The pressure exerted by water at rest.

**2.2.8 Laitance:** A thin, weak, brittle layer of cement and aggregate fines on a concrete surface. The amount of laitance is influenced by the degree of working or amount of water in the concrete.

**2.2.9 Outgassing:** The upward and outward emission of air or moisture vapor from concrete.

**2.2.10 Surface Porosity:** Porosity or permeability at the concrete surface that may absorb vapors, moisture, chemicals, and coating liquids. Small interconnected voids which allow fluids to penetrate an otherwise impervious material.

**2.2.11 Surface Hardeners:** Compounds applied to a concrete surface to improve hardness, and to decrease permeability.

## 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Sections 3.3 through 3.6 and form a part of this Guide.

**3.2** The latest issue, revision, or amendment of the reference standards in effect on the date of invitation to bid should govern unless otherwise specified.

### 3.3 SSPC STANDARDS:

| | |
|---|---|
| **PA Guide 1** | Shop, Field and Maintenance Painting of Steel |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **SP 1** | Solvent Cleaning |

### 3.4 ASTM STANDARDS:

| | |
|---|---|
| **D 3359** | Test Methods for Measuring Adhesion by Tape Test |

Provided by : www.spic.ir Licensee: NISOC Library

**D 3363** Test Method for Film Hardness by Pencil Test

**D 4138** Test Method for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive Means

**D 4258** Practice for Surface Cleaning Concrete for Coating

**D 4259** Practice for Abrading Concrete

**D 4260** Practice for Acid Etching Concrete

**D 4263** Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

**D 4414** Practice for Measurement of Wet Film Thickness of Organic Coatings by Notch Gages

**D 4541** Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

**D 4787** Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates

**D 5064** Process for Conducting a Patch Test to Assess Coating Compatibility

**D 6132** Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Over Concrete Using an Ultrasonic Gage

**3.4.1 ASTM PUBLICATION:**

**ASTM 2800809014, 1990:** Manual on Maintenance Coatings for Nuclear Power Plants

**3.5 NACE INTERNATIONAL (NACE) STANDARDS:**

**6G191** Committee Report on Surface Preparation of Contaminated Concrete for Corrosion Control

**RP0188** Standard Recommended Practice for Discontinuity (Holiday) Testing of Protective Coatings

**RP0172** Surface Preparation of Steel and Other Hard Materials by Water Blasting Prior to Coating or Recoating

**RP0288** Inspection of Lining on Steel and Concrete

**3.6 AMERICAN CONCRETE INSTITUTE (ACI) STANDARDS:**

**116R** Cement and Concrete Terminology

**224.1R** Causes, Evaluation, and Repair of Cracks in Concrete Structures

**504R** Guide to Joint Sealants for Concrete Structures

## 4. Surface Preparation of Concrete

**4.1 REQUIREMENTS FOR PREPARING NEW CONCRETE FOR COATING APPLICATION:**

**4.1.1 Verify Concrete Cure:** Unless otherwise recommended by the coating manufacturer, cure new concrete a minimum of 28 days before application of coatings. (See Note 9.2.)

**4.1.2 Check for Excess Moisture:** Prior to application of coatings, check for the presence of moisture beneath the surface according to the Plastic Sheet Method described in ASTM D 4263. Other appropriate alternate test methods may be submitted for consideration. Conduct the test on representative sections of each pour. If moisture is present, consult the coating manufacturer for required action.

**4.1.3 Remove Surface Contaminants:** Remove oil, grease, dirt, water, or other foreign contaminants before applying coatings. The concrete surface also needs to be free of excess water unless coating systems tolerant to damp surfaces are employed. Use methods described in 4.3.3.

**4.1.4 Remove Surface Hardeners:** If a surface hardener has been used on the concrete to be coated, abrasive blasting or some other means of mechanical surface preparation must be used to remove the hardener and roughen the surface. Use methods described in Section 4.3.2.

**4.1.5 Remove Efflorescence and Laitance:** Efflorescence and laitance shall be removed in accordance with methods described in Section 4.3.1 or 4.3.2. Laitance can create an eggshell surface over hidden voids; if not removed before painting, the laitance may disintegrate and leave unfilled holes on the surface, or cause the coating to disbond.

**4.1.6 Remove Curing Membrane:** Remove any curing membrane if required by the specification or if it is determined that the membrane would interfere with the adhesion or performance of the applied coating. Membranes shall be removed in accordance with methods in Section 4.3.2 or 4.3.4; consult manufacturer for recommended method.

**4.1.7 Roughen Concrete Surface for Improved Adhesion:** Roughen the concrete if required by the specification using the methods specified in 4.3.1 or 4.3.2. (See Note 9.3.)

**4.1.8 Repair Forming Defects:** The contracting parties should agree in advance on the treatment of defects which must be repaired. Repair and remove or fill all form voids, honeycombs, fins, and other surface irregularities

Provided by : www.spic.ir Licensee: NISOC Library

with a suitable repair or patching product which is compatible with the coating to be applied. Grind all form ties or other metallic protrusions below the surface and then patch or fill with a suitable material prior to coating. Consult manufacturers for recommendation on suitable patching materials and cure times before coating application.

**4.1.9 Repair Cracks:** Concrete cracks may be caused by external factors, concrete shrinkage, or thermal stress. Some may be anticipated to exhibit movement in the future. The contracting parties should agree in advance on the treatment of cracks which must be repaired. Critical factors include cleaning and preparation methods, and the physical dimensions of the crack, as well as the anticipated future movement of the crack.

**4.2 REQUIREMENTS FOR PREPARING AGED CONCRETE FOR COATING APPLICATION:**

**4.2.1 Evaluate General Condition of Concrete:** Visually inspect for loose or deteriorated concrete. Identify any previous coatings and any deterioration in the condition (e.g., flaking, peeling, delamination). If possible, identify any contaminants on the surface such as chemicals, oil, or grease, residues of concrete, hardeners or curing membrane. Refer to NACE Standard 6G1-91.

**4.2.2 Determine Compatibility of New Coating with Existing Coating:** If portions of the existing coating are sound and intact, determine the compatibility of the new coating with the existing coating in accordance with ASTM D 5064. If coating is incompatible with the existing coating, the existing coating must be removed using methods in Sections 4.3.2 and 4.3.4.

**4.2.3 Remove Surface Contaminants:** Oil, grease, dirt, or other foreign contaminants should be removed before applying coatings. Use methods described in 4.3.3. The concrete surface also needs to be free of excess water unless coating systems tolerant of damp surfaces are employed.

**4.2.4 Remove Efflorescence and Laitance:** Efflorescence and laitance shall be removed in accordance with methods described in Section 4.3.1 or 4.3.2. The contracting parties should agree in advance on the amount of laitance which may remain on the surface. Laitance can create an eggshell surface over hidden voids; if not removed before painting, the laitance may disintegrate and leave unfilled holes on the surface, or cause the coating to disbond.

**4.2.5 Remove Chemical Contaminants:** Chemicals may have contaminated the surface due to exposure to chemical fumes, chemical immersion, or other conditions. Remove chemical contaminants using methods in 4.3 or by special methods to be established. If deep penetration is suspected, core sampling to at least one-third of the slab depth is recommended. Refer to NACE 6G1-91.

**4.2.6 Produce Sound Surface:** Ensure a sound surface with adequate surface roughness using methods in 4.3.1 or 4.3.2. If the surface or subsurface integrity is questionable, tapping on the surface with a small hammer will detect hollow spots or weak concrete. See Note 9.6.

**4.2.7 Repairing Defects:** Evaluate and repair cracks, voids, and other defects in the concrete in accordance with owner's specifications. Refer to ACI 224.1R-89.

**4.3. METHODS OF CONCRETE SURFACE PREPARATION:**

**4.3.1 Acid Etching:** A procedure for acid etching of concrete surfaces is given in ASTM D 4260. Acid etching must be used with caution because of the detrimental effect of residual acid or unremoved salts on coating adhesion and performance. This method is primarily used for horizontal surfaces. Practicality and personnel safety make it prohibitive to acid etch overhead concrete surfaces at the present time. While vertical surfaces are not normally acid etched, if acid etching is used on those surfaces, care must be taken to keep the concrete wet with the acid until the desired end result is achieved. Acid etching with hydrochloric acid may be prohibited because of its residual effects upon various metal surfaces (such as stainless steel) located in the area. Hydrochloric acid is not permitted to be used in nuclear facilities.

**4.3.2 Abrading Concrete:** Concrete may be abraded by methods such as air abrasive blasting, portable centrifugal wheel blasting, power tool cleaning, water jetting, wet blasting with abrasive injection, rotary peening, or scarifying. Relevant standards include ASTM D 4259 and NACE RP 0172-72. A representative area of concrete at the jobsite can be prepared as specified and used as an acceptance standard after its acceptability is agreed on by involved parties. Note that some methods of abrading concrete may result in surface or subsurface weakening which is not immediately detectable.

**4.3.3 Surface Contaminant Removal:** Cleaning methods include vacuuming, broom cleaning, air blast cleaning, low pressure water cleaning (less than 5,000 psi, [34 mPa]) detergent cleaning, and steam cleaning. These methods are described in ASTM D 4258 and SSPC-SP 1. If solvent cleaning is needed to remove oil and grease, it is to be performed before abrading. Consult coating manufacturers for recommended methods for cleaning of concrete. Before recoating, remove all residues of cleaning agents and strippers from surface. Refer to NACE Publication 6G1-91.

Provided by : www.spic.ir Licensee: NISOC Library

**4.3.4 Chemical Stripping:** Previously applied coatings will usually be removed using the methods given in 4.3.2 but some coatings may be removed by chemical stripping. Chemical stripping consists of the application of a solvent or alkaline gel which strips the existing coating from the underlying concrete. Perform chemical stripping only after consulting with the coating manufacturer.

Before recoating, remove all residues of cleaning agents and strippers from surface.

**4.4 SPECIAL CONDITIONS:** Expansion/control joints, joint sealants, floor drains, and floor termination points and corners, floor-to-wall intersections, or upturns all require special attention. High traffic areas may require additional coating thickness or entail rebuilding during maintenance. Consult respective manufacturers for recommended procedures for surface preparation and coating application. Refer to ACI 504R-90 for information on joint sealants.

## 5. Application of Coatings

**5.1 ENVIRONMENTAL CONDITIONS:** Apply coatings according to specifications regarding the air and substrate temperature, dew point, and relative humidity. Consult the manufacturer's latest published technical data sheets and application instructions. Also observe recommendations given in SSPC-PA 1.

**5.2 SPECIAL PRECAUTIONS:**

**5.2.1 Protecting Below-Grade Concrete:** For concrete slabs or walls at or below grade that will be internally coated with essentially impervious systems, a vapor barrier is mandatory on the unprotected side of the concrete. These below-grade exterior surfaces of concrete structures need a complete vapor barrier system, such as a coating or sheet membrane, to create a continuous barrier in order to be effective.

**5.2.2 Outgassing:** To minimize problems associated with outgassing, coatings should not be applied when concrete temperature is rising.

**5.2.3 Surface Porosity:** For concrete with unacceptable porosity, a filler or surface sealer may be required.

**5.2.4** Observe other special precautions or requirements as specified by the owner.

**5.3 PRE-APPLICATION PROCEDURES:**

**5.3.1 Data Sheets:** Ensure that the manufacturer's latest published product application data sheets and material safety data sheets (MSDS) are available and reviewed before starting any job.

**5.3.2 Mixing and Thinning:** Ensure that each individual coating or component is thoroughly mixed before combining them. Any required induction or "sweat-in" time must be observed. Any thinning should be performed only after this time period, and in conformance with manufacturer's recommendations and applicable VOC regulations. See SSPC-PA 1 for general guidelines.

**5.3.3 Equipment:** All application and mixing equipment shall be free of contaminants and be operated and maintained in accordance with the latest published instructions from the manufacturer.

**5.4 COATINGS APPLICATION**

**5.4.1 General:** Coating shall be applied in accordance with the manufacturer's recommendations and according to good coating application practice as described in SSPC-PA 1.

**5.4.2 Surface Cleanliness:** The surface cleanliness of all prepared surfaces should be inspected after cleaning and drying but prior to making repairs or applying the coating. Prepared concrete surfaces may be inspected for surface cleanliness by lightly rubbing the surface with a dark cloth or pressing a translucent adhesive tape on the surface. The acceptable level of residual dust should be consistent with the coating manufacturer's recommendations for the type of coating to be applied. (See Section 4.3.3 for a discussion of removal of chemical contaminants.)

**5.4.3 Wet and Dry Film Thickness:** The film thickness shall be within the minimum and maximum levels specified for each coat. Wet film thickness should be monitored in accordance with ASTM D 4414. Dry paint thickness can be estimated based on coverage rates and volume solids, or can be measured using methods stated in 6.1.

## 6. Inspection

**6.1 DRY FILM THICKNESS:** Measure dry film thickness of coatings up to 50 mils (1.2 mm) in accordance with ASTM D 4138. This method will require patching of the coating. Dry film thickness may also be measured with an ultrasonic gauge, in accordance with ASTM D 6132, which will not damage the coating film.

**6.2 ADHESION:** Measure the bond strength of the coating to the concrete in accordance with ASTM D 3359 or ASTM D 4541. These methods will usually require patching of the coating and may require patching of the concrete.

**6.3 HOLIDAY DETECTION:** When specified, inspect for holidays in accordance with NACE RP-0188-90 or ASTM D 4787. If holidays are found, or if holidays have to be

Provided by : www.spic.ir Licensee: NISOC Library

intentionally made to ground the holiday detector, patching of the coating may be required.

**6.4 CURE OF THE APPLIED COATING:** Determine adequacy of cure using a method agreed upon by the coating applicator, the coating manufacturer, and the specifier. Suitable methods may include solvent rub, Barcol hardness test for thick films, or pencil hardness test (ASTM D 3363). (See Note 9.4.)

## 7. Safety, Health, and Environmental Compliance

**7.1 SAFETY AND HEALTH:** Activities described in this standard shall be done in accordance with all safety and health precautions as described in the MSDS and relevant portions of SSPC-PA Guide 3, in addition to any applicable Federal, state, and local rules and requirements.

**7.2 ENVIRONMENTAL COMPLIANCE:** Activities described in this standard shall be done in compliance with applicable Federal, state and local environmental regulations.

## 8. Disclaimer

While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, paints or methods specified therein, or of the specification or standard itself.

## 9. Notes

Notes contain supplementary information and are not considered part of the guide.

**9.1** The following ACI Standards, while not referenced in this document, may provide additional helpful information:

| | |
|---|---|
| 302.1R-89 | Guide for Concrete Floor and Slab Construction |
| 224R-89 | Control of Cracking in Concrete Structures |
| 503.3-92 | Standard Specification for Producing Skid-Resistant Surface on Concrete by the Use of a Multi-Component Epoxy System |
| 515.1R-79A | Guide to the Use of Waterproofing, Damp-proofing, Protective and Decorative Barrier Systems for Concrete |

**9.2** New concrete generally requires a minimum 28-day curing time under favorable environmental conditions to achieve its design strength. Certain products, however, are designed to be applied over “damp” or “green” concrete, and can serve as curing membranes.

**9.3** Roughening the concrete surface will provide greater surface area for adhesion between the coating and the concrete. The finishing method for the concrete should be specified, taking into consideration the type of coating system to be used.

**9.4** The cure of the coating needs to be considered when using chemically cured or moisture-cured coating materials. Factors influencing the cure are temperature, humidity, formulation, film thickness, and reduction (“thinning”). Follow the coating manufacturer’s recommendations before applying additional coats and before placing the coated surface in service.

**9.5** The ASTM Manual of Coating Work for Light-Water Nuclear Power Plant Primary Containment and Other Safety-Related Facilities contains photographs of bug holes.

**9.6** For information on surface preparation of contaminated concrete, refer to NACE Publication 6G1-91, “Surface Preparation of Contaminated Concrete for Corrosion Control.”

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC: The Society for Protective Coatings

# GUIDE NO. 12

## Guide for Illumination of Industrial Painting Projects

## 1. Scope

**1.1** This guide provides information on the quantity and quality of lighting on industrial painting projects that is conducive to achieving quality surface preparation and coating application, productivity, inspection/quality control, and accident prevention.

**1.2** This guide is intended for use by facility owners, specifiers, designers, and contractors.

## 2. Background

**2.1** Lighting standards have been established for most industrial applications by the American National Standards Institute (ANSI). One standard addresses the temporary lighting conditions common to most industrial painting projects. ANSI Z117.1, "Safety Requirements for Working in Tanks and Other Confined Spaces," establishes minimum requirements for safe entry, continued work in, and exit from tanks and other confined spaces. The ANSI standard sets entry procedures which include the use of a permit to authorize illumination of the space. No specific criteria on illumination are stated.

**2.2** Adequate illumination improves productivity and motivation while poor illumination increases the risk of accidents and costs of operation. Additional illumination beyond recommended levels may be beneficial but not essential to achieving these objectives. In addition, unnecessarily high lighting levels add to the cost of procurement, installation, and maintenance and may have a negative impact on safety and productivity due to increased glare. Light with substantial color bias, regardless of foot candles, can hinder the observation of the true condition of the work surface.

**2.3** While natural lighting or use of white containment materials may provide adequate levels of illumination, once the decision to use artificial lighting to illuminate a work area is made, portions of the National Fire Protection Association (NFPA) and Occupational Safety and Health Administration (OSHA) regulations on portable lamps and wiring installation have direct application. However, an integrated guide specific to the coatings industry is necessary to help establish minimum standards on quality and quantity of light, as well as consolidate applicable electrical hazard controls.

**2.4** Refer to any and all appropriate sections which pertain to portable lamps: NFPA 70, "National Electric Code" and OSHA regulations 29 CFR Sections 1926.402-408.

**2.5** The recommended levels of illumination contained in this guide are a result of both objective and subjective examination of lighting conditions in a variety of work spaces: tanks, containments, blast and paint rooms, shop floors, and other situations where similar conditions exist. The resulting lighting recommendations are believed to be comfortable for the workers, contributing to distortion-free work surfaces and adequate levels of illumination for performing general surface preparation, painting and inspection activities in the work space. Natural lighting, artificial lighting, or a combination of the two may be used to achieve the levels specified in this guide.

## 3. References

**3.1** The standards referenced in this guide are listed in Sections 3.4 through 3.7 and form a part of this guide.

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

**3.3** If there is a conflict between the requirements of any of the cited reference standards and this guide, the requirements of this guide shall prevail.

**3.4 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARDS:**

| | |
|---|---|
| **RP7** | Practice for Industrial Lighting |
| **Z117.1** | Safety Requirements for Confined Spaces |

**3.5 FEDERAL SPECIFICATIONS AND STANDARDS:**

**Code of Federal Regulations Title 29, Chapter XVII, Occupational Safety and Health Administration (OSHA):**

| | |
|---|---|
| **Part 1910** | **Occupational Safety and Health Standards, Subpart J--General Environmental Controls** |
| **29 CFR 1910.146** | **Permit-required confined spaces** |
| | **Part 1926--Safety and Health Regulations for Construction,** |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| | **Subpart K- Electrical, Installation Safety Requirements** |
| **29 CFR 1926.402** | Applicability |
| **29 CFR 1926.403** | General requirements |
| **29 CFR 1926.404** | Wiring design and protection |
| **29 CFR 1926.405** | Wiring methods, components, and equipment for general use |
| **29 CFR 1926.406** | Specific purpose equipment and installation |
| **29 CFR 1926.407** | Hazardous (classified) locations |
| **29 CFR 1926.408** | Special systems |
| **29 CFR 1926.449** | Definitions applicable to Subpart K--Electrical |

**3.6 NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) STANDARDS:**

| | |
|---|---|
| **70** | National Electric Code |

**3.7 UNDERWRITERS' LABORATORIES (UL) STANDARDS, ANSI APPROVED:**

| | |
|---|---|
| **298** | Portable Electric Hand Lamps |
| **1570** | Fluorescent Lighting Fixtures |
| **1571** | Incandescent Lighting Fixtures |
| **1572** | High Intensity Discharge Lighting Fixtures |

## 4. Definitions

**Confined space:** Per 29 CFR 1910.146, a confined space is a space that: (1) is large enough and so configured that an employee can bodily enter and perform assigned work; and (2) has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry); and (3) is not designed for continuous occupancy.

**Foot candles:** A unit of illumination; the illumination at a point on a surface which is one foot from, and perpendicular to, a uniform point source of one candle.

**General work area lighting:** The level of illumination throughout a work area, measured at various locations on the horizontal work plane, at least six feet from the nearest light source.

**Non-permit required confined space:** A confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical injury.

**Permit required confined space:** A confined space that has one or more of the following characteristics: (1) contains or has the potential to contain a hazardous atmosphere; (2) contains a material that has the potential for engulfing an entrant; (3) has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or (4) contains any other recognized safety or health hazard.

**Task-specific lighting:** The level of illumination required for performing specific visual tasks (e.g., inspection).

**White light:** Light containing all wavelengths in the visible range at similar intensity.

## 5. General Conditions

### 5.1 MONITORING STRATEGY

**5.1.1 Quantity of Existing (Natural) Light:** Some natural light will be present in most work areas during daylight hours and the color of any containment materials (e.g., white tarps) may improve natural light. The amount of natural light will depend on factors such as time of year, time of day, orientation of the work area, and prevailing weather conditions. Although it is not likely that the quantity and quality of natural light will be sufficient for work in most confined spaces, the amount of additional lighting necessary to meet the recommendations of this guide will be affected by the amount of ambient natural light available. Measurements should be made with a light meter held at or placed on the surface. With the sensor aligned perpendicular to the surface, make a minimum of five measurements which are representative of the work area. Record each and calculate the average of the measurements.

**5.1.2 Effect of Airborne Dust:** Airborne dust will reduce visibility. Consideration must be given to the amount of loose debris which may be created during paint removal or application operations. Depending on the expected concentration of airborne dust, provisions may be required for its removal prior to the start of work in order for adequate illumination to be achieved.

**5.2 CLASSIFICATION OF LOCATIONS:** Once the evaluation of the work area is complete the work locations should be classified as one of the following:

**5.2.1 Hazardous locations** where the potential for explosion and/or fire exists. Hazardous locations are defined as those locations where quantities of flammable gases or vapors, explosives, combustible dusts, fibers, or flyings are present or likely to become present. Lighting fixtures used in hazardous locations must be explosion proof and Underwriters Laboratory or Factory Mutual approved for use in the appropriate Class and Division atmosphere.

See Appendix A for a discussion of hazardous locations.

**5.2.2 Non-Hazardous locations** where the potential for explosion and/or fire does not exist. Lighting fixtures used in nonhazardous locations must be designed to UL Standard 298.

**5.2.3 Wet locations** where installations are underground or in concrete slabs or masonry in direct contact with the

Provided by : www.spic.ir Licensee: NISOC Library

earth, and locations subject to saturation with water or other liquids, such as unprotected locations exposed to weather.

Lighting fixtures used in wet locations must be designed to ANSI/UL 1570, 1571, or 1572.

## 6. Illumination Requirements

**6.1** A light meter with readings in foot candles should be used to verify the adequacy of the illumination. For general work area measurements, the meter should be placed on a horizontal plane parallel with the work surface (e.g., walking across staging). For task specific measurements, the meter should be held at, or placed on, the surface, with the sensor aligned perpendicular to the surface. Make a minimum of five measurements representative of the work area or task. Compare the average to the criteria in Table 1 and Table 2.

## 7. Recommendations

The recommendations below are applicable for any artificial lighting required to achieve adequate illumination of a given work area or specific task.

### 7.1 ALL LOCATIONS

**7.1.1** All lighting equipment must be durable and designed for the intended work environment.

**7.1.2** Portable lamps and fixtures should be encased in a nonconductive, shatterproof material, which serves as an electrical insulator providing additional protection from electrical shock, abrasion, and corrosion resistance. Lamps and fixtures should also be equipped with substantial guards to prevent contact with personnel, containment materials, etc.

**7.1.3** Use only heavily insulated cable with an abrasive resistant casing, at least gage 14/2 SO AWG or heavier and designed for hard or extra-hard usage, per NFPA 70 (e.g., types S, ST, SO, STO).

**7.1.4** Use of white light is recommended, as it is closest to natural light. White light does not visually distort the surface being worked on or being inspected. Lighting equipment capable of providing white light should be selected for task specific lighting where practical.

**Table 1**
**WORK AREA ILLUMINATION REQUIRMENTS IN FOOT CANDLES[1]**

| | Minimum | Recommended |
|---|---|---|
| General Work Area[2] | 10 | 20 |
| Task specific - surface preparation and coating application[3] | 20 | 50 |
| Task specific - inspection | 50 | 200 |

[1]Based upon levels of illumination recommended for sample occupational tasks in ANSI/IES RP 7.
[2]The level of illumination throughout a work area, measured at various locations on the horizontal work-plane, at least 6 feet (2 m) from the nearest light sources. (See Section 6.1). An illumination level of 20 foot candles is recommended for corridors, scaffolds, and other walking surfaces.
[3]The level of illumination for performing specific visual tasks (i.e., surface preparation, coating application, and inspection) measured at the work surface in conjunction with the intended light source (See Section 6.1)

**Table 2**
**MAXIMUM LUMINANCE RATIOS[1]**

| | |
|---|---|
| Between task and adjacent darker surroundings[2] | 5 to 1[3] |
| Between task and adjacent lighter surroundings | 1 to 5 |

[1] Maximum luminance ratios recommended are based upon areas (indoor or outdoor) where it is completely impractical to control reflectances and difficult to alter environmental conditions.
[2]The eyes function more efficientlly and comfortably when the illumination levels within the work environments are not too different from those of the seeing task.
[3]Based upon maximum luminance ratios from ANSI/IES RP 7

Provided by : www.spic.ir Licensee: NISOC Library

**7.2 NONHAZARDOUS, WET LOCATIONS:** All lighting fixtures having an electrical supply service greater than 12 volts must be properly grounded, have ground fault circuit interrupter (GFCI) protection, or have an integrated circuit breaker wired into the specific electrical line supplying the power to the light fixture.

## 8. Proper Use and Maintenance of Lighting Equipment

### 8.1 LIGHTING FIXTURES

**8.1.1** All lighting systems should be removed from the direct spray of paint, abrasives, or other materials. Impacts of air flow patterns from any ventilation system in operation should also be considered. Paint overspray with accumulations on fixtures reduces the amount of light emitted and restricts heat dispersement of the light, which may cause premature failure or overheating.

**8.1.2** Do not tape over the lens or cover areas designed for heat dispersement, as this may cause severe damage to the fixture and significantly reduces bulb life.

**8.1.3** Do not drop or drag lighting fixtures.

### 8.2 POWER CORDS AND CONNECTORS

**8.2.1** Periodically inspect GFCIs, plugs, integrated circuit breakers, and power cords, as well as all power cord connections.

**8.2.2** Do not modify or otherwise alter connectors. Use an outlet that is compatible with the connector.

**8.2.3** Immediately replace or repair any device or cable that appears to be worn or broken.

### 8.3 REPAIRS

**8.3.1** Disconnect power and remove any lights or electrical apparatus needing repair outside any hazardous atmosphere before performing repairs.

**8.3.2** All connections, seals and assemblies must be repaired per the manufacturer's instructions, using the manufacturer's recommended parts.

**8.3.3** Parts for repair other than those specified by the manufacturer of the lighting system should not be used.

**8.3.4** Replacement bulbs other than those specified by the manufacturer of the lighting system should not be used.

## 9. Disclaimer

This material has been developed under the published procedures of SSPC: The Society for Protective Coatings, which has been designed to assure the appointment of technically competent committees having balanced representation. While these procedures assure the highest degree of care, neither SSPC, its members, nor those participating in its activities accept any liability resulting from compliance or noncompliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

SSPC has no power or authority to police or enforce compliance with the contents of this document, and any certification of products stating compliance with requirements of this document is made at the peril of the certifier.

## 10. Notes

Notes are not a requirement of this guide.

**10.1** Air cooled lighting systems, which direct the flow of compressed air across the lens or around the globe, help to keep the lens free of contaminants, prolong bulb life, and generally are of higher intensity required for the lighting of areas with high concentrations of airborne dust.

**10.2 OTHER PERTINENT STANDARDS:** Other industry standards which may be pertinent for illumination in industrial painting projects are listed below.

**10.2.1 National Fire Protection Association (NFPA) Standards:**

| | |
|---|---|
| **70E** | Standard for Electrical Safety Requirements for Employee Workplaces |
| **77** | Recommended Practice on Static Electricity |
| **497A** | Recommended Practice for the Classification of Class I Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas |
| **497B** | Recommended Practice for the Classification of Class II Hazardous (Classified) Locations for Electrical Installation in Chemical Process Areas |
| **497M** | Manual for Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous (Classified) Locations |
| **654** | Standard for Prevention of Fire and Dust Explosions in Chemical, Dye, Pharmaceutical, and Plastics Industries |

**10.2.2 Underwriters' Laboratories (UL) Standards, ANSI Approved:**

| | |
|---|---|
| **781** | Portable Electric Lighting Units for Use in Hazardous (Classified) Locations |

Provided by : www.spic.ir Licensee: NISOC Library

## Appendix A. Explosion Hazards

### A. 1 BACKGROUND

Achieving acceptable levels of illumination by natural or artificial means in the industrial painting industry is complicated due to the complexity of structures, vision inhibiting dust, and potentially hazardous concentrations of explosive dust or solvent vapors. This appendix has been added to provide some direction, but is not considered a requirement of this guide.

### A. 2 DEFINITIONS

Hazardous locations are classified as Class I, Class II, or Class III depending upon the physical properties of the substances which are present. These classes are further subdivided as Division 1 or Division 2.

**Class I locations:** Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. Class I locations include the following:

**Class I Division 1:** A Class I Division I location is a location (a) in which hazardous concentrations of gases or vapors may exist under normal operating conditions or (b) in which hazardous concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage or (c) in which breakdown or faulty operation of equipment or processes might release hazardous concentrations (e.g., greater than 10% of the Lower Explosive Limit) of flammable gases or vapors and might also cause simultaneous failure of electric equipment.

**Class I, Division 2:** A Class I, Division 2 location is a location (a) in which volatile flammable liquids or flammable gases are handled, processed or used, but in which the hazardous liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operations of equipment, or (b) in which hazardous concentrations of gases or vapors are normally prevented by positive mechanical ventilation, and which might become hazardous through failure or abnormal operations of the ventilation equipment, or (c) that is adjacent to a Class I, Division 1 locations and to which hazardous concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

**Class II locations:** Class II locations are those that are hazardous because of the presence of combustible dust. Class II locations include the following:

**Class II, Division 1:** A Class II, Division 1 location is a location: (a) in which combustible dust is or may be in suspension in the air under normal operating conditions, in quantities sufficient to produce explosive or ignitable mixtures; or (b) where mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electric equipment, operation of protection devices, or from other causes, or (c) in which combustible dusts of an electrically conductive nature may be present.

**Class II, Division 2:** A Class II, Division 2 location is a location in which: (a) combustible dust will not normally be in suspension in the air in quantities sufficient to produce explosive or ignitable mixtures, and dust accumulations are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus; or (b) dust may be in suspension in the air as a result of infrequent malfunctioning of handling or processing equipment, and dust accumulations may be ignitable by abnormal operation or failure of electrical equipment or other apparatus.

**Class III locations:** Class III locations are those that are hazardous because of the presence of easily ignitable fibers or flyings (e.g., dust) but in which such fibers or flyings are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures. Class III locations include the following:

**Class III, Division 1:** A Class III, Division 1 location is a location in which easily ignitable fibers or materials producing combustible flyings are handled, manufactured, or used.

**Class III, Division 2:** A Class III, Division 2 location is a location in which easily ignitable fibers are stored or handled, except in process of manufacture.

Note: The above definitions of hazardous (classified) locations are taken directly from 29 CFR 1926.449. Refer to the OSHA standard for additional information and examples for each classification.

**Hazardous Atmosphere:** An atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness from one or more of the following causes: (1) flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL); (2) airborne combustible dust at a concentration that meets or exceeds its LFL; (3) atmospheric oxygen concentration below 19.5% or above 23.5%; (4) atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in subpart G, Occupational Health and Environmental Control, or in subpart Z, Toxic and Hazardous Substances, which could result in

Provided by : www.spic.ir Licensee: NISOC Library

employee exposure in excess of its dose or permissible exposure limit; (5) any other atmospheric condition that is immediately dangerous to life or health. NOTE: This definition is taken directly from 29 CFR 1910.146. For the purposes of this guide, only those considerations in selecting lighting dealing with the concentrations of flammable vapors or combustible dusts [items (1) and (2) above] are addressed. The reader is cautioned to consider all other aspects of a hazardous atmosphere as described above.

**Lower Flammable Limit:** The lower limit of flammability of a gas or vapor at ordinary ambient temperatures expressed in percent of the gas or vapor in air by volume. Lower Flammable Limit is synonymous with Lower Explosive Limit.

**A.3 EVALUATION OF WORK SITES:** Before any aspect of an industrial painting project commences, the location must be evaluated to determine whether a hazardous atmosphere exists. This evaluation involves a thorough inspection of the work location and often includes both a visual inspection and monitoring for atmospheric hazards.

OSHA's permit-required confined space standard (29 CFR 1910.146) requires that employers test and monitor spaces with instruments which detect all aspects of hazardous atmospheres that may be encountered. OSHA has classified atmospheric hazards into three categories: toxic; asphyxiating; and flammable or explosive atmospheres. Monitoring tests are typically performed using a direct reading instrument which gives an instantaneous assessment of the degree of atmospheric hazard.

From a lighting perspective, the minimum required tests in any suspect hazardous atmosphere include oxygen level, the concentration of flammable gases or vapors, and the concentration of combustible dust.

**A.4 SURVEY CONSIDERATIONS:** Initial testing for hazards may not be enough. Periodic or continuous testing may be required, as conditions can change and become hazardous during the painting project. Conditions may also vary throughout a work space. Concentrations of flammable gases and vapors may vary depending on their physical characteristics (i.e., heavier gases may tend to concentrate near the bottom of tightly sealed spaces while light gases may concentrate near their emission source or near the top of the space). With this in mind, a monitoring strategy must be developed which takes into account both the physical properties of potential atmospheric hazards and the physical characteristics of the structure. The instrumentation used to monitor the atmosphere must be classified as intrinsically safe or Underwriters' Laboratories (UL) or Factory Mutual (FM) approved for Class I, Division 1 atmospheres.

**A.5 HAZARDOUS LOCATIONS, CLASS I AND CLASS II**

**A.5.1** Explosion proof lighting will be used whenever painting with a paint containing combustible solvents or performing any operation which introduces combustible compounds into a confined space.

**A.5.2** All explosion proof lighting fixtures used must be designed to comply with the requirements of NFPA 70.

**A.5.3** All related connectors must be rated in the same manner or be located outside the hazardous location/work space.

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC: The Society for Protective Coatings
# GUIDE 13
## Guide for the Identification and Use of Industrial Coating Material in Computerized Product Databases

## 1. Scope

**1.1 INTRODUCTION:** Databases are essential in organizing and reporting technical information such as product data and test results. The first step in developing a database for industrial coating material is to identify the parameters that are essential for characterizing coating material identifiers and properties. The Society for Protective Coatings/ Computer-Integrated Knowledge System Network (SSPC/ CIKS) Joint Coating Working Group has prepared this guide for formatting data on coating material for use in preparing product data sheets in hardcopy format and computerized databases. Significant benefits will be realized due to the increased emphasis on the electronic representation and exchange of information. The guide will provide a consistent format that will simplify data transfer among coating industry manufacturers, coating suppliers, and coating users. The benefits will include an increased awareness of the properties of coating material through consistent terminology and the identification of data elements, and the ability to exchange product data represented in computerized systems such as databases. The development of this guide is consistent with the principles laid down by ASTM Committee E-49 on "Computerization of Material and Chemical Property Data." The organization of the guide was strongly influenced by ASTM E 1309 (Guide for Identification of Composite Materials in Computerized Material Property Databases) and ASTM E 1338 (Guide for Identification of Metals and Alloys in Computerized Material Property Databases).

**1.2 OBJECTIVE**: The objective of this document is to provide a general structure for coating product data. Product data includes manufacturer identifiers, physical properties, performance parameters, and recommendations on use. This guide is intended to simplify the exchange of similarly complete sets of data between different computerized databases and to promote a consistent representation for the exchange of coating product data in paper form. It suggests the subject matter to be included in a coating material product database. It is not intended to be an all-inclusive list of data to be stored and it is not a database. Implementation of this guide does not have to include all the data elements listed within, and there are no constraints on how data should be displayed in specific databases.

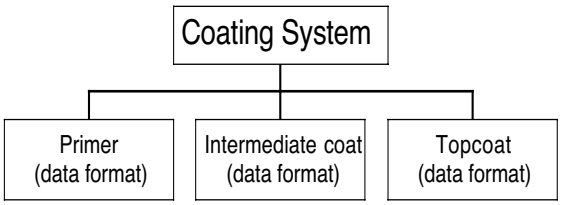
The guide presents parameters needed to characterize industrial coating product data. It includes data elements (fields) needed to uniquely identify a coating material, to describe its properties, and to report manufacturer's recommendations on its use.

## 2. Terminology

**2.1 TERMS SPECIFIC TO INDUSTRIAL COATING MATERIAL:** Terms specific to industrial coating material Industrial coating material is defined in Steel Structures Painting Manual, Volume 1, Appendix B. Other industrial coating material related terms used in this guide are defined in documents listed in Section 5.

**2.2 TERMS USED IN THIS GUIDE:** Terms used to describe the components of an industrial coating system include primer, intermediate, and topcoat. A diagram showing the components is presented in Figure 1. In practice, when describing a coating system, it is assumed that multiple representations (e.g. product data sheets, data files, data records) of this guide will be necessary. For example, a database record could contain product data on a primer, intermediate, or topcoat. The database records could reside in a single database file or in separate files, designated as "primer data file," "intermediate coat data file," or "topcoat data file." A database consists of data files that are composed of data segments and data elements.

**Figure 1: Components of a coating system**




**2.2.1 Coating product database:** a data file consisting of data segments and data elements in which product data representing individual or multiple manufacturer identifiers and properties are stored.

**2.2.2 Data record:** a complete coating product database entry that contains coating material product data representing a single manufacturer and coating system component, comprised of data segments.

**2.2.3 Data segment:** a category of information that is used to subdivide and designate sets of related data elements.

Provided by : www.spic.ir Licensee: NISOC Library

**2.2.4 Data element:** an individual piece of information used in describing a material or recording test results; for example, a variable name or test parameter.

Note: Certain data segments may be used repeatedly to report information and properties of a particular coating. Each data element in this guide is represented by a data element number, data element name, data element type, and data element format.

**2.2.5 Data element number:** a three or five-digit number used to denote an individual data element.

Note: These numbers represent the entire set of information in a particular data element. Data element numbers are considered a functional part of the guide and may be used for data element reference. The first three digits of the data element number identify the data segment. The two digits following the decimal point identify the specific data element within a data segment. A data element number that contains "XX" following the decimal point is used to denote multiple occurrences (e.g. properties, tests) for an individual data element.

**2.2.6 Data element name:** a descriptive term or title that designates the type of information or data to be reported in the data element.

**2.2.7 Data element type:** a designation of "essential", "essential if applicable", or "desirable" that reflects the significance of the data element entry.

Note: Data elements are designated "essential" if they are necessary to make a meaningful comparison of product data from different sources. A comparison of data from different sources may still be possible if essential information is omitted, but the value of the comparison may be greatly reduced.

**2.2.8 Data element format:** the presentation style used to report information or data.

Note: Alphanumeric, floating point, and special entry formats may be specified in this guide for use in reporting information, unit designations, numerical values, and test results.

## 3. Data Segments

**3.1 Introduction:** Seven data segments represent categories of information that are necessary for the identification of an industrial coating and for recording its product data. They are:

- Product description
- Intended use
- Physical properties
- Mixing and application
- Key performance parameters
- Safety data
- Supplemental information

Each data segment is identified and defined in Section 3.2. Table 1 lists the data segments and their data element number range designation. Table 2 identifies the data elements associated with each data segment. See pages 6-8.

### 3.2 DATA SEGMENT DEFINITIONS

**3.2.1 Product description:** Fifteen data elements used to represent the manufacturer information, identify the coating system component, and certification.

**3.2.2 Intended use:** Ten data elements used to describe manufacturer's recommendations on use of the coating material.

**3.2.3 Physical properties (as applied material):** Thirteen data elements that describe the physical properties, including test results for the wet material.

**3.2.4 Mixing and application:** Thirty data elements that provide guidance on the mixing and application of the coating material.

**3.2.5 Key performance parameters:** Twenty-nine data elements that identify test methods and results for the coating material.

**3.2.6 Safety:** Six data elements that describe safety data and considerations for the coating material.

**3.2.7 Supplementary information:** One data element that describes manufacturer supplementary comments regarding identification, properties, and use of the coating material.

## 4. Data Elements

**4.1 Introduction:** Each data segment is subdivided into sets of data elements that are used to report either essential, essential if applicable, or desirable information. Data elements for data segments are defined in the following sections. The use of SI units is preferred and the reporting of all properties in SI units is always required. It is also desirable to include English units (in parenthesis), following the SI unit specification.

### 4.2 PRODUCT DESCRIPTION

**4.2.1 Product name (essential):** the name established by the manufacturer to uniquely identify the coating material.

**4.2.2 Product identification (essential):** a unique identification number established by the manufacturer to uniquely identify the coating material.

**4.2.3 Manufacturer name (essential):** the name of the coating manufacturer.

Provided by : www.spic.ir Licensee: NISOC Library

**4.2.4 Manufacturer address (desirable):** the manufacturer street or post office box address for use in communicating written documents.

**4.2.5 Manufacturer city designation (desirable):** the manufacturer city for use in communicating written documents.

**4.2.6 Manufacturer state designation (desirable):** the manufacturer state for use in communicating written documents.

**4.2.7 Manufacturer zip code designation (desirable):** the manufacturer zip code for use in communicating written documents.

**4.2.8 Manufacturer country designation (desirable):** the manufacturer country name for use in communicating written documents.

**4.2.9 Manufacturer telephone number (essential):** telephone number for the manufacturer.

**4.2.10 Manufacturer facsimile number (desirable):** facsimile number of the manufacturer.

**4.2.11 Manufacturer electronic mail address (desirable):** electronic mail address of the manufacturer.

**4.2.12 Manufacturer World Wide Web Universal Resource Locator (URL) address (desirable):** Internet World Wide Web address for the manufacturer.

**4.2.13 Generic type (essential):** identifies the generic coating material type based on the primary resin system.

**4.2.14 System component (essential):** identifies the coating system component.

**4.2.15 Certification/qualification (desirable):** identifies a certification or qualification assigned to the coating material.

**4.3 INTENDED USE**

**4.3.1 Common use (essential):** identifies the suitable application areas. Piping and highway bridges are examples of use areas.

**4.3.2 Substrate type (essential):** identifies the recommended compatible substrate(s).

**4.3.3 Exposure environment (essential):** recommended exposure environment(s). Examples of standard exposure environments are defined in SSPC Painting Manual, Volume 2.

**4.3.4 Surface preparation specification (essential):** recommended surface preparation specification for application of the coating material.

**4.3.5 Compatible undercoat (essential if applicable):** identifies a compatible undercoat.

**4.3.6 Compatible topcoat (essential if applicable):** identifies a compatible topcoat.

**4.3.7 Continuous dry temperature limitation (essential if applicable):** specifies the acceptable continuous temperature limitation reported in degrees Celsius and Fahrenheit.

**4.3.8 Intermittent dry temperature limitation (essential if applicable):** specifies the acceptable intermittent temperature limitation reported in degrees Celsius and Fahrenheit.

**4.3.9 Chemical temperature limitation (essential if applicable):** specifies the acceptable elevated temperature for chemical environment reported in degrees Celsius and Fahrenheit.

**4.3.10 Wet temperature limitation (essential if applicable):** specifies the acceptable wet temperature limitation reported in degrees Celsius and Fahrenheit.

**4.4 PHYSICAL PROPERTIES (AS APPLIED MATERIAL)**

**4.4.1 Volume solids (essential):** specifies the percent volume solids test result.

**4.4.2 Volume solids test method (essential):** identifies the test method used to determine the volume solids percent.

**4.4.3 Solids by weight (essential):** specifies the percent solids by weight test result.

**4.4.4 Solids by weight test method (essential):** identifies the test method used to determine the weight solids percent.

**4.4.5 Volatile organic compounds (VOC) (essential):** identifies the volatile organic compound content in grams/liter and lbs/gallon test result.

**4.4.6 Volatile organic compounds (VOC) test method (essential):** identifies the test method used to determine the volatile organic compound content.

**4.4.7 Component density (desirable):** identifies the mixing component density in grams/liter and lbs/gallon.

**4.4.8 Mixed density (desirable):** identifies the density test result in grams/liter and lbs/gallon.

**4.4.9 Density test method (desirable):** identifies the test method used to determine the density.

Provided by : www.spic.ir Licensee: NISOC Library

**4.4.10 Storage and transport temperature (desirable):** specifies the acceptable temperature range for storing and transporting the coating material in degrees Celsius and Fahrenheit.

**4.4.11 Shelf life (essential):** identifies the recommended shelf life in months.

**4.4.12 Finish (desirable):** identifies the type of coating component finish.

**4.4.13 Color (desirable):** identifies the color or range of colors available for the coating.

**4.5 MIXING AND APPLICATION**

**4.5.1 Dry-to-handle (essential):** identifies the dry-to-handle time in hours at a specified temperature reported in degrees Celsius and Fahrenheit.

**4.5.2 Dry-to-handle test method (essential):** identifies the test method used to determine the dry-to-handle test results.

**4.5.3 Dry-to-touch (essential):** identifies the dry-to-touch time in hours.

**4.5.4 Dry-to-touch test method (essential):** identifies the test method used to determine the dry-to-touch test results.

**4.5.5 Maximum recoat time (essential):** identifies the recommended maximum overcoat time in hours.

**4.5.6 Temperature for maximum recoat time (essential)**: the temperature used to determine the maximum recoat value reported in degrees Celsius and Fahrenheit.

**4.5.7 Minimum recoat time (essential):** identifies the recommended minimum overcoat time in hours.

**4.5.8 Temperature for minimum recoat time (essential):** the recommended minimum recoat time temperature reported in degrees Celsius and Fahrenheit.

**4.5.9 Maximum recommended dry film application thickness (essential):** identifies the recommended maximum dry film application thickness, reported in micrometers and mils.

**4.5.10 Minimum recommended dry film application thickness (essential):** identifies the recommended minimum dry film application thickness, reported in micrometers and mils.

**4.5.11 Theoretical coverage per volume (essential):** identifies the surface area coverage for volume of coating at a specified dry film thickness, reported in square meters (and square feet) per volume.

**4.5.12 Maximum ambient temperature (essential):** identifies the recommended maximum ambient temperature for application reported in degrees Celsius and Fahrenheit.

**4.5.13 Minimum ambient temperature (essential):** identifies the recommended minimum ambient temperature for application in degrees Celsius and Fahrenheit.

**4.5.14 Maximum surface temperature (essential):** identifies the recommended application surface temperature range in degrees Celsius and Fahrenheit.

**4.5.15 Minimum surface temperature (essential):** identifies the recommended application surface temperature range in degrees Celsius and Fahrenheit.

**4.5.16 Maximum humidity (essential):** identifies the recommended maximum relative humidity for application, reported in percent.

**4.5.17 Minimum humidity (essential):** identifies the recommended minimum relative humidity for application, reported in percent.

**4.5.18 Dew point range (essential):** identifies the recommended application dew point/surface temperature range in degrees Celsius and Fahrenheit.

**4.5.19 Thinner (essential):** identifies the recommended thinner.

**4.5.20 Clean-up solvent (essential):** identifies the recommended clean-up solvent.

**4.5.21 Parts (essential if applicable):** identifies the required number of parts for mixing.

**4.5.22 Mixing method (essential if applicable):** identifies the recommended method for mixing.

**4.5.23 Mixing ratio (essential if applicable):** identifies the required ratio for mixing parts.

**4.5.24 Induction time (essential if applicable):** identifies the induction time in hours.

**4.5.25 Temperature for induction time (essential if applicable):** identifies the induction time temperature in degrees Celsius and Fahrenheit.

**4.5.26 Pot life (essential if applicable):** identifies the pot life in hours.

**4.5.27 Pot life temperature (essential if applicable):** identifies the pot life temperature in degrees Celsius and Fahrenheit.

**4.5.28 Application method (desirable):** identifies the recommended application method(s).

Provided by : www.spic.ir Licensee: NISOC Library

**4.5.29 Agitation requirements (desirable):** identifies the recommended agitation requirements during application.

**4.5.30 Curing mechanism (desirable):** identifies the curing mechanism.

**4.6 KEY PERFORMANCE PARAMETERS**

**4.6.1 Corrosion resistance (desirable):** corrosion resistance test results.

**4.6.2 Corrosion resistance test parameters (desirable):** corrosion resistance test parameters.

**4.6.3 Corrosion resistance test method (desirable):** identifies the method used to determine the corrosion resistance.

**4.6.4 Weathering (desirable):** weathering test results for gloss, color retention, chalking, and checking.

**4.6.5 Weathering test parameters (desirable):** identifies the test parameters used to conduct the weathering test.

**4.6.6 Weathering test method (desirable):** identifies the test method used to determine weathering.

**4.6.7 Abrasion resistance (desirable):** abrasion resistance test results.

**4.6.8 Abrasion resistance test parameters (desirable):** identifies the test parameters used to conduct the test for abrasion resistance.

**4.6.9 Abrasion resistance test method (desirable):** identifies the test method used to determine abrasion resistance.

**4.6.10 Temperature resistance (desirable):** temperature resistance test results.

**4.6.11 Temperature resistance test parameters (desirable):** identifies the parameters used to conduct the temperature test.

**4.6.12 Temperature resistance test method (desirable):** identifies the test method used to determine temperature resistance.

**4.6.13 Selected chemical resistance (desirable):** selected chemical resistance test results.

**4.6.14 Selected chemical resistance test parameters (desirable):** identifies the parameters used to conduct the selected chemical resistance test.

**4.6.15 Selected chemical resistance test method (desirable):** identifies the test method used to determine the selected chemical resistance.

**4.6.16 Impact resistance (desirable):** impact resistance test results.

**4.6.17 Impact resistance test parameters (desirable):** identifies the parameters used to conduct the impact resistance test.

**4.6.18 Impact resistance test method (desirable):** identifies the test method used to determine impact resistance.

**4.6.19 Permeability (desirable):** permeability test results.

**4.6.20 Permeability test parameters (desirable):** identifies the parameters used to conduct the permeability test.

**4.6.21 Permeability test method (desirable):** identifies the test method used to determine permeability.

**4.6.22 Adhesion (desirable):** adhesion test results.

**4.6.23 Adhesion test parameters (desirable):** identifies the parameters used to conduct the adhesion test.

**4.6.24 Adhesion test method (desirable):** identifies the test method used to determine adhesion.

**4.6.25 Elongation (desirable):** elongation test results.

**4.6.26 Elongation test parameters (desirable):** identifies the parameters used to conduct the elongation test.

**4.6.27 Elongation test method (desirable):** identifies the test method used to determine elongation.

**4.6.28 Tensile strength (desirable):** tensile strength test results reported in percent.

**4.6.29 Tensile strength test method (desirable):** identifies the test method used to determine tensile strength.

**4.7 SAFETY**

**4.7.1 Part identification (essential):** Identifies the coating component part for which the safety data is being reported.

**4.7.2 NFPA health hazard (desirable):** identifies the National Fire Protection Association health hazard rating number.

**4.7.3 NFPA flammability (desirable):** identifies the National Fire Protection Association flammability rating number.

**4.7.4 NFPA reactivity (desirable):** identifies the National Fire Protection Association reactivity rating number.

Provided by : www.spic.ir Licensee: NISOC Library

**4.7.5 Flash point (essential):** identifies the flash point in degrees Celsius and Fahrenheit.

**4.7.6 Flash point test method (essential):** identifies the test method used to determine the flash point.

**4.8 MANUFACTURER SUPPLEMENTAL INFORMATION**

**4.8.1 Manufacturer comments (desirable):** additional information provided by the manufacturer to aid in the selection or use of the coating material.

**Table 1: Coating Material Product Data Segment and Data Element Numeric Ranges**

| DATA SEGMENT NUMBER RANGE | DATA SEGMENT NAME |
|---|---|
| 100-199 | Product description |
| 200-299 | Intended use |
| 300-399 | Physical properties |
| 400-499 | Mixing and application |
| 500-599 | Key performance parameters |
| 600-699 | Safety data |
| 700-799 | Manufacturer's supplemental information |

**Table 2: Data Elements for the Definition of Industrial Coating Product Data**
**Product Description Data Segment (see Section 4.2)**

| NUMBER[A] | ELEMENT NAME | TYPE[B] | FORMAT |
|---|---|---|---|
| 100 | Product name | Essential | Alphanumeric String |
| 101 | Product identification | Essential | Alphanumeric String |
| 102 | Manufacturer name | Essential | Alphanumeric String |
| 103.xx | Manufacturer address[c] | Desirable | Alphanumeric String |
| 104 | Manufacturer city designation | Desirable | Alphanumeric String |
| 105 | Manufacturer state designation | Desirable | Alphanumeric String |
| 106 | Manufacturer zip code designation | Desirable | Alphanumeric String |
| 107 | Manufacturer country designation | Desirable | Alphanumeric String |
| 108 | Manufacturer telephone number | Essential | Alphanumeric String |
| 109 | Manufacturer facsimile number | Desirable | Alphanumeric String |
| 110 | Manufacturer electronic mail address | Desirable | Alphanumeric String |
| 111 | Manufacturer World Wide Web Universal Resource Locator address | Desirable | Alphanumeric String |
| 112 | Generic type | Essential | Alphanumeric String |
| 113.xx | System component[c] | Essential | Alphanumeric String |
| 114 | Certification/qualification | Desirable | Alphanumeric String |

**Intended Use Data Segment (see Section 4.3)**

| NUMBER | DATA ELEMENT NAME | TYPE | FORMAT |
|---|---|---|---|
| 200.xx | Common use[c] | Essential | Alphanumeric String |
| 201.xx | Substrate type[c] | Essential | Alphanumeric String |
| 202.xx | Exposure environment | Essential | Alphanumeric String |
| 203.xx | Surface preparation specification[c] | Essential | Alphanumeric String |
| 204.xx | Compatible undercoat[c] | Essential if applicable | Alphanumeric String |
| 205.xx | Compatible topcoat[c] | Essential if applicable | Alphanumeric String |
| 206 | Continuous dry temperature limitation | Essential if applicable | Alphanumeric String |
| 207 | Intermittent dry temperature limitation | Essential if applicable | Alphanumeric String |

[a] Data element numbers are a functional part of the guide.
[b] All data elements are considered desirable. Reporting essential data elements is strongly recommended.
[c] The data fields for this data segment shall be repeated for each data element.



Provided by : www.spic.ir Licensee: NISOC Library

| | | | |
|---|---|---|---|
| 208 | Chemical temperature limitation | Essential if applicable | Alphanumeric String |
| 209 | Wet temperature limitation | Essential if applicable | Alphanumeric String |

**Physical Properties (as applied material) Data Segment (see Section 4.4)**

| NUMBER | DATA ELEMENT NAME | TYPE | FORMAT |
|---|---|---|---|
| 300 | Volume solids | Essential | Floating Point |
| 301 | Volume solids test method | Essential | Alphanumeric String |
| 302 | Solids by weight | Essential | Floating Point |
| 303 | Solids by weight test method | Essential | Alphanumeric String |
| 304 | Volatile organic compounds | Essential | Floating Point |
| 305 | Volatile organic compounds test method | Essential | Alphanumeric String |
| 306 | Component density | Desirable | Floating Point |
| 307 | Mixed density | Desirable | Floating Point |
| 308 | Density test method | Desirable | Alphanumeric String |
| 309 | Storage and transport temperature | Desirable | Numeric |
| 310 | Shelf life | Essential | Alphanumeric String |
| 311 | Finish | Desirable | Alphanumeric String |
| 312.xx | Color[c] | Desirable | Alphanumeric String |

**Mixing and Application Data Segment (see Section 4.5)**

| NUMBER | DATA ELEMENT NAME | TYPE | FORMAT |
|---|---|---|---|
| 400 | Dry-to-handle | Essential | Numeric |
| 401 | Dry-to-handle test method | Essential | Alphanumeric String |
| 402 | Dry-to-touch | Essential | Numeric |
| 403 | Dry-to-touch test method | Essential | Alphanumeric String |
| 404 | Maximum recoat time | Essential | Numeric |
| 405 | Temperature for maximum recoat time | Essential | Floating Point |
| 406 | Minimum recoat time | Essential | Numeric |
| 407 | Temperature for minimum recoat time | Essential | Floating Point |
| 408 | Maximum recommended dry film application thickness | Essential | Floating Point |
| 409 | Minimum recommended dry film application thickness | Essential | Floating Point |
| 410 | Theoretical coverage per volume | Desirable | Floating Point |
| 411 | Maximum ambient temperature | Essential | Floating Point |
| 412 | Minimum ambient temperature | Essential | Floating Point |
| 413 | Maximum surface temperature | Essential | Floating Point |
| 414 | Minimum surface temperature | Essential | Floating Point |
| 415 | Maximum humidity | Essential | Floating Point |
| 416 | Minimum humidity | Essential | Floating Point |
| 417 | Dew point range | Essential | Floating Point |
| 418 | Thinner | Essential | Alphanumeric String |
| 419 | Clean-up solvent | Essential | Alphanumeric String |
| 420 | Parts | Essential if applicable | Alphanumeric String |
| 421 | Mixing method | Essential if applicable | Alphanumeric String |
| 422 | Mixing ratio | Essential if applicable | Alphanumeric String |
| 423.xx | Induction time[c] | Essential if applicable | Numeric |
| 424.xx | Temperature for induction time | Essential if applicable | Floating Point |
| 425 | Pot life[c] | Essential if applicable | Numeric |
| 426 | Pot life temperature | Essential if applicable | Floating Point |
| 427.xx | Application method[c] | Desirable | Alphanumeric String |
| 428 | Agitation requirements | Desirable | Alphanumeric String |
| 429 | Curing mechanism | Desirable | Alphanumeric String |

[c] The data fields for this data segment shall be repeated for each data element.



Provided by : www.spic.ir Licensee: NISOC Library

**Key Performance Parameters Data Segment (see Section 4.6)**

| NUMBER | DATA ELEMENT NAME | TYPE | FORMAT |
|---|---|---|---|
| 500.xx | Corrosion resistance[c] | Desirable | Alphanumeric String |
| 501.xx | Corrosion resistance test parameters | Desirable | Alphanumeric String |
| 502.xx | Corrosion resistance test method[c] | Desirable | Alphanumeric String |
| 503.xx | Weathering[c] | Desirable | Alphanumeric String |
| 504.xx | Weathering test parameters | Desirable | Alphanumeric String |
| 505.xx | Weathering test method[c] | Desirable | Alphanumeric String |
| 506 | Abrasion resistance | Desirable | Alphanumeric String |
| 507 | Abrasion resistance test parameter | Desirable | Alphanumeric String |
| 508 | Abrasion resistance test method | Desirable | Alphanumeric String |
| 509 | Temperature resistance | Desirable | Floating Point |
| 510 | Temperature resistance test parameter | Desirable | Alphanumeric String |
| 511 | Temperature resistance test method | Desirable | Alphanumeric String |
| 512.xx | Selected chemical resistance | Desirable | Floating Point |
| 513.xx | Selected chemical resistance test parameter | Desirable | Alphanumeric String |
| 514.xx | Selected chemical resistance test method | Desirable | Alphanumeric String |
| 515 | Impact resistance | Desirable | Floating Point |
| 516 | Impact resistance test parameter | Desirable | Alphanumeric String |
| 517 | Impact resistance test method | Desirable | Alphanumeric String |
| 518 | Permeability | Desirable | Floating Point |
| 519 | Permeability test parameter | Desirable | Alphanumeric String |
| 520 | Permeability test method | Desirable | Alphanumeric String |
| 521 | Adhesion | Desirable | Floating Point |
| 522 | Adhesion test parameter | Desirable | Alphanumeric String |
| 523 | Adhesion test method | Desirable | Alphanumeric String |
| 524 | Elongation | Desirable | Floating Point |
| 525 | Elongation test parameter | Desirable | Alphanumeric String |
| 526 | Elongation test method | Desirable | Alphanumeric String |
| 527 | Tensile strength | Desirable | Floating Point |
| 528 | Tensile strength test method | Desirable | Alphanumeric String |

**Safety Data Segment (see Section 4.7)**

| NUMBER | ELEMENT NAME | TYPE | FORMAT |
|---|---|---|---|
| 600.xx | Part identification | Essential if applicable | Alphanumeric String |
| 601.xx | NFPA health hazard | Desirable | Numeric |
| 602.xx | NFPA flammability | Desirable | Numeric |
| 603.xx | NFPA reactivity | Desirable | Numeric |
| 604.xx | Flash point | Essential | Numeric |
| 605.xx | Flash point test method | Essential | Numeric |

**Manufacturer's Supplementary Information (see Section 4.8)**

| NUMBER | ELEMENT NAME | TYPE | FORMAT |
|---|---|---|---|
| 700 | Manufacturer's comments | Desirable | Alphanumeric String |

## 5. Reference documents and definition of terms cited in this guide

**Coatings Encyclopedic Dictionary,** LeSota, S. (Ed.), Blue Bell, PA, Federation of Societies for Coatings Technology, 1995.

**Identification of Metals and Alloys in Computerized Material Property Databases,** ASTM E-1338-90, West Conshohocken, PA, American Society for Testing and Materials, 1990.

Provided by : www.spic.ir Licensee: NISOC Library

**Identification of Composite Materials in Computerized Material Property Databases,** ASTM E-1309-92, West Conshohocken, PA, American Society for Testing and Materials, 1992.

**Industrial Maintenance Coatings Glossary,** SSPC 94-16, Pittsburgh, PA, Technology Publishing Company, 1994.

**Systems and Specifications: Steel Structures Painting Manual,** Volumes 1 and 2, Pittsburgh, PA, SSPC: The Society for Protective Coatings, 1993.

## 6. Appendix A: Example Use of the Guide

**Table A: Coating Product Data Example** [1]
**Product Description Data Segment**

| NUMBER | NAME | EXAMPLE ENTRY |
|---|---|---|
| 100 | Product name | Chembuild |
| 101 | Product identification | Series 135 |
| 102 | Manufacturer name | Tnemec |
| 103.01 | Manufacturer address | P.O. Box 411749 |
| 104 | Manufacturer city designation | Kansas City |
| 105 | Manufacturer state designation | Missouri |
| 106 | Manufacturer zip code designation | 64141-1749 |
| 107 | Manufacturer country designation | United States |
| 108 | Manufacturer telephone number | 816-483-3400 |
| 112 | Generic type | High-build, high-solids catalyzed epoxy |
| 113 | System component | Primer |

**Intended Use Data Segment**

| NUMBER | NAME | EXAMPLE ENTRY |
|---|---|---|
| 200.01 | Common use | Machinery |
| 200.02 | Common use | Pipes |
| 200.03 | Common use | Bridges |
| 200.04 | Common use | Industrial facility steel structures |
| 201 | Substrate type | Structural steel |
| 202 | Exposure environment | Atmospheric |
| 203.01 | Surface preparation specification | SSPC-SP 2 |
| 203.02 | Surface preparation specification | SSPC-SP 3 |
| 205.01 | Compatible topcoat | Series 66 Hi-Build Epoxoline |
| 205.02 | Compatible topcoat | Series 70 & 71 Endura-Shield |
| 205.03 | Compatible topcoat | Series 72 Endura-Shield II |
| 205.04 | Compatible topcoat | Series 73 Endura-Shield III |
| 205.05 | Compatible topcoat | Series 73 Endura-Shield IV |
| 205.06 | Compatible topcoat | Series 104 H.S. Epoxy |
| 206 | Continuous dry temperature limitation | 250° F, 121° C |
| 207 | Intermittent dry temperature limitation | 275° F, 135° C |

Provided by : www.spic.ir Licensee: NISOC Library

**Physical Properties (as applied material) Data Segment**

| NUMBER | DATA ELEMENT NAME | EXAMPLE ENTRY |
|---|---|---|
| 300 | Volume solids, percent | 83 |
| 304 | Volatile organic compounds, g/L (lb/gal) | 142 (1.2) |
| 307 | Mixed density, g/L (lb/gal) | 12.61 (0.11) |
| 309 | Storage and transport temperature | Max 120° F, 49° C, Min 20° F, 7° C |
| 310 | Shelf life, months | 12 |
| 311 | Finish | Semi-gloss |
| 312.01 | Color | Off-white |
| 312.02 | Color | Select CHROMACOLORS |

**Mixing and Application Data Segment**

| NUMBER | DATA ELEMENT NAME | EXAMPLE ENTRY |
|---|---|---|
| 400 | Dry-to-handle, WFT, micrometers (mils), hours at °C (F) | 127 µm (5 mils),18 h, 23.8° C (75° F) |
| 402 | Dry-to-touch, WFT, micrometers (mils), hours at °C (F) | 127 µm (5 mils), 6 h, 23.8° C (75° F) |
| 404 | Maximum recoat time, hours | 3 |
| 407 | Minimum recoat time, hours | 24 |
| 408 | Maximum recommended dry film application thickness | 9 µm (4 mils) |
| 409 | Minimum recommended dry film application thickness | 4 µm (4 mils) |
| 410 | Theoretical coverage per volume | 16-36 $m^2$ (149-335 $ft^2$) |
| 413 | Maximum surface temperature | 135° F, 57° C |
| 414 | Minimum surface temperature | 50° F, 10° C |
| 417 | Dew point range | 80° F, 27° C |
| 418 | Thinner | #19 spray, #18 brush, roller |
| 419 | Clean-up solvent | Methyl Ethyl Ketone |
| 420 | Parts | 2 |
| 421 | Mixing method | Stirring |
| 422 | Mixing ratio | 4 part A: 1 part B |
| 423 | Induction time, hours | 30 |
| 424 | Pot life, hours | 4 |
| 425 | Pot life temperature | 72° F, 22° C |
| 426.01 | Application method | Spray |
| 426.02 | Application method | Brush |
| 426.03 | Application method | Roller |
| 427 | Agitation requirements | None |
| 428 | Curing mechanism | Chemical reaction |

**Key Performance Parameters Data Segment**

| NUMBER | DATA ELEMENT NAME | EXAMPLE ENTRY |
|---|---|---|
| 500 | Corrosion resistance | No blister, crack, rust, < 1/64 creep at scribe |
| 502 | Corrosion resistance test method | ASTM B117 |
| 506 | Abrasion resistance | < 130 mg loss |
| 507 | Abrasion resistance test parameter | +1000 cycles |
| 508 | Abrasion resistance test method | ASTM D3359 |
| 515 | Impact resistance | >28 inch-lbs |
| 517 | Impact resistance test method | ASTM D2794 |
| 521 | Adhesion | > 850 psi |
| 523 | Adhesion test method | ASTM D4541 |
| 524 | Elongation | > 16% |
| 526 | Elongation test method | ASTM D522 Conical Mandrel |

Provided by : www.spic.ir Licensee: NISOC Library

**Safety Data Segment**

| NUMBER | DATA ELEMENT NAME | EXAMPLE ENTRY |
|---|---|---|
| 603 | Flash point | 75° F, 24° C |
| 604 | Flash point test method | SETA |

**Table B: Coating Product Data Example 2**
**Product Description Data Segment**

| NUMBER | NAME | EXAMPLE ENTRY |
|---|---|---|
| 100 | Product name | Carbomastic |
| 101 | Product identification | 15 |
| 102 | Manufacturer name | Carboline |
| 103.01 | Manufacturer address | 1401 S. Hanley Road |
| 104 | Manufacturer city designation | St. Louis |
| 105 | Manufacturer state designation | Missouri |
| 106 | Manufacturer zip code designation | 63144-2985 |
| 107 | Manufacturer country designation | United States |
| 108 | Manufacturer telephone number | 314-644-1000 |
| 112 | Generic type | Waterborne epoxy |
| 113 | System component | Top coat |
| 114 | Certification/qualification | Bay Area Quality Management District, Reg 8, Rules 3 and 19 |

**Intended Use Data Segment**

| NUMBER | NAME | EXAMPLE ENTRY |
|---|---|---|
| 200.01 | Common use | Metal building |
| 200.02 | Common use | Piping |
| 200.03 | Common use | Process equipment |
| 200.04 | Common use | Highway bridges |
| 201 | Substrate type | Steel |
| 202 | Exposure environment | Atmospheric |
| 203.01 | Surface preparation specification | SSPC-SP 2 |
| 203.02 | Surface preparation specification | SSPC-SP 3 |
| 204.01 | Compatible undercoat | Inorganic primers |
| 204.02 | Compatible undercoat | Organic zinc oxide primers |
| 206 | Continuous dry temperature limitation | 180° F, 82° C |
| 207 | Intermittent dry temperature limitation | 250° F, 121° C |

**Physical Properties (as applied material) Data Segment**

| NUMBER | DATA ELEMENT NAME | EXAMPLE ENTRY |
|---|---|---|
| 300 | Volume solids (percent) | 90 |
| 301 | Volume solids test method | ASTM D 2697 |
| 309 | Storage and transport temperature | 45-110° F, 7-43° C |
| 310 | Shelf life (months) | 24 |
| 312 | Color | Aluminum |

Provided by : www.spic.ir Licensee: NISOC Library

**Mixing and Application Data Segment**

| NUMBER | DATA ELEMENT NAME | EXAMPLE ENTRY |
|---|---|---|
| 404 | Maximum recoat time | 6 days @ 40 ºF, 4 ºC |
| 406 | Minimum recoat time | 8 hours @ 90 ºF, 32 ºC |
| 409 | Minimum recommended dry film application thickness | 4 mils (125 microns) 7 mils (175 microns) |
| 410 | Theoretical coverage per volume | 289 sq ft (7.2 sq m/l @ 125 microns) per gallon |
| 413 | Maximum surface temperature | 130 ºF, 54 ºC |
| 414 | Minimum surface temperature | 32 ºF, 0 ºC |
| 415 | Maximum humidity | 100 |
| 416 | Minimum humidity | 0 |
| 417 | Dew point range | 5 °F, 2 °C |
| 418 | Thinner | Carbomastic thinner |
| 419 | Clean-up solvent | Carbomastic thinner #2 |
| 420 | Parts | 2 |
| 421 | Mixing method | Power mix |
| 422 | Mixing ratio | 1 Part A: 1 Part B |
| 424 | Pot life | 4 |
| 425 | Pot life temperature | 75 °F, 24 °C |
| 426.01 | Application method | Spray |
| 426.02 | Application method | Brush |
| 426.03 | Application method | Roller |

**Key Performance Parameters Data Segment**

| NUMBER | DATA ELEMENT NAME | EXAMPLE ENTRY |
|---|---|---|
| 506 | Abrasion resistance | Fair |
| 524 | Elongation | Excellent |

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# GUIDE 14

## Guide for the Repair of Imperfections in Galvanized or Inorganic Zinc Coated Steel Using Organic Zinc-Rich Coating

## 1. Scope

**1.1** This guide describes one method for repairing galvanizing or inorganic zinc coating using an organic zinc-rich coating. ASTM A 780 briefly describes this and other alternative methods (metallizing and zinc-based solders) for repair of damaged and uncoated areas of hot-dip galvanized coatings.

**1.2** This method is intended to repair imperfections resulting from application, welding, cutting, drilling, grinding, abrading, or rough handling during transport or erection. It may also be used to repair imperfections in galvanizing or inorganic zinc coating that have occurred from weathering during storage or after erection.

**1.3** This method can also be used to repair topcoated galvanizing or inorganic zinc coating.

## 2. Description

**2.1** This method consists of selecting organic zinc-rich coatings and topcoats and preparing and applying the coatings to damaged galvanizing or inorganic zinc coating.

**2.2** This method is intended for repairing localized imperfections where the major portion of the existing zinc coating is intact.

**2.3** Organic zinc-rich coatings are suitable for repairing damaged zinc coatings because they combine several favorable properties. They can be readily applied by brush or spray under field conditions to small and irregular shapes and are compatible with both zinc and steel substrates.

## 3. References

**3.1** The standards listed here are listed in Sections 3.4 through 3.7 and form a part of this guide. A standard marked with an asterisk (*) is referenced only in the Notes, which are not requirements of the guide.

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

**3.3** 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.

**3.4 SSPC AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Coating Thickness with Magnetic Gages |
| **PA Guide 3** | A Guide to Safety in Paint Application |
| **Paint 5** | Zinc Dust, Zinc Oxide, and Phenolic Varnish Paint |
| **Paint 20** | Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic) |
| **Paint 29** | Zinc Dust Sacrificial Primer, Performance-Based |
| **PS Guide 8** | Guide to Topcoating Zinc-Rich Paints |
| **PS Guide 12.00** | Guide to Zinc-Rich Coating Systems |
| **SP 1** | Solvent Cleaning |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |
| **SP 11** | Power Tool Cleaning to Bare Metal |
| **SP 12/NACE No. 5** | Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultrahigh Pressure Water Jetting Prior to Recoating |
| **SP 14/NACE No. 8** | Industrial Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **A 123** | Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| **A 153** | Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| **A 780** | Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |
| * **D 3960** | Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coating* |

Provided by : www.spic.ir Licensee: NISOC Library

* **D 4457** Test Method for Analysis of Dichloromethane and 1,1,1 - Trichloromethane in Paints and Coatings by Direct Injection into a Gas Chromatograph

**D 6133** Test Method for Acetone Content of Solvent-Reducible and Water-Reducible Paints, Coatings, Resins and Raw Materials by Direct Injection into a Gas Chromatograph

**3.6 BAY AREA AIR QUALITY MANAGEMENT DISTRICT (BAAQMD)**

* **Method 41** Determination of Volatile Organic Compounds in Solvent-Based Coatings and Related Material Containing Parachlorobenzotrifluoride

**3.7 CALIFORNIA AIR RESOURCES BOARD (CARB):**

* **Method 310** Test Method for Antiperspirants and Deodorants, Consumer Products, and Aerosol Coating Products

## 4. Selecting Materials

**4.1 GENERAL:** Compositions and performances of organic zinc-rich primers vary with regard to the individual resin system, the level of metallic zinc, the volatile organic compound (VOC) content, along with other formulation variables. It is often desirable to require the zinc-rich coatings to meet performance criteria to verify that they can withstand the corrosion and weathering environments to which they will be subjected. Some performance tests are described in SSPC-Paint 20 and SSPC-Paint 29. Coating selection can best be made from actual field testing of candidate coatings in the environment in which the coatings are to be located.

**4.2 TYPE OF BINDER:** Organic zinc-rich coating formulations are available with a variety of binders. The choice of a particular generic type of binder is up to the user. A list of some of the currently available generic types is found in Note 7.1.

**4.3 METALLIC ZINC LEVELS:** Suppliers, applicators, and owners do not agree on the metallic zinc level (or loading) necessary for long-term protection of steel by organic zinc-rich coatings. The user can select any metallic zinc level found to provide the best performance, or conversely, not specify a zinc level. Three levels of zinc loading that may be useful to the user are listed below:

- Zinc Level 1: Minimum zinc loading of 85% by weight of the dry film
- Zinc Level 2: Minimum zinc loading of 77% by weight of the dry film
- Zinc Level 3: Minimum zinc loading of 65% by weight of the dry film

The above levels may be used to specify zinc loading of repair products meeting requirements of SSPC-Paints 5, 20, and 29 and ASTM A 780. The user may specify any percentage of zinc loading (for example 95%) if desired.

**4.4 VOLATILE ORGANIC COMPOUND (VOC) CONTENT:** The VOC content of a merchantable coating meeting the compositional and performance requirements of this specification may vary widely. The specifier should consult applicable government regulations to determine the maximum allowable VOC content and the proper VOC test method for their application. As a part of the purchase

**4.5 TOPCOAT SELECTION:** If a topcoat is to be applied over the zinc-rich primer, select the topcoat in accordance with SSPC-PS Guide 8. (See Note 7.3.)

## 5. Procedures

**5.1 SURFACE PREPARATION:**

**5.1.1** Visually identify damaged areas based on deterioration of the zinc, rusting of steel substrate, disbondment, or other defects of the zinc coating.

**5.1.2** Select surface preparation methods. Suitable methods include SSPC-SP 2 or SP 3, SSPC-SP 11, SSPC-SP 12/NACE No. 5, or abrasive blasting (SSPC-SP 5/NACE No. 1, SSPC-SP 10/NACE No. 2, SSPC-SP 6/NACE No. 3, SSPC-SP 14/NACE No. 8, or SSPC-SP 7/NACE No. 4), depending upon the service environment.

Table 1 can be used as a general guideline for appropriate surface preparation for a variety of exposures. In all cases, the surface cleanliness should be at least as great as that recommended by the supplier of the primer.

**5.1.3 Surface Contaminants:** Remove all grease, oil, corrosion by-products, dirt, and other surface contaminants from the areas with imperfections and from the existing intact coating within a minimum of five centimeters (two inches) of these areas by solvent cleaning or detergent washing (SSPC-SP 1), or other approved method.

**5.1.4 Topcoated Areas:** If any of the areas to be repaired consist of topcoated galvanized steel or topcoated inorganic zinc, all loose topcoat in the damaged area must be completely removed exposing an area of intact zinc coating surrounding the damaged area.

**5.1.5 Weld Preparations:** If the area to be repaired contains welds, all flux residue and weld spatter must be removed by blast cleaning or through mechanical means. (See Section 4.4.1 of SSPC Surface Preparation Commentary regarding removal of weld spatter.)

Provided by : www.spic.ir Licensee: NISOC Library

**Table 1**

**Recommended Minimum Surface Preparation**

| Service Environment | Dry Abrasive Blast | Water Jetting (SP-12/NACE No 5) | Hand or Power Tool Cleaning |
|---|---|---|---|
| Immersion | SP 10/NACE No. 2 | WJ 2/SC 1* | None |
| Splash/Spillage | SP 6/NACE No. 3 | WJ 3/SC 2 | SP 11 |
| Chemical Fume, Neutral pH | SP 6/NACE No. 3 | WJ 3/SC 2 | SP 11 |
| Atmospheric | SP 7/NACE No. 4 | WJ 4/SC 3 | SP 2 or 3 |

* Note that SP 2 requires specification of visual cleanliness (WJ 1 through WJ 4) and non-visual cleanliness (SC 1 through SC 3).

**5.2 REPAIRS WITH ZINC-RICH COATING:**

**5.2.1 Application:** Apply the zinc-rich coating to the prepared surface by brush or spray according to the manufacturer's recommendations and SSPC-PA 1. If a conflict exists between SSPC-PA 1 and the manufacturer's printed recommendations, the latter should be followed. The patch of organic zinc-rich coating must extend a minimum of five centimeters (two inches) over the undamaged zinc coated surface. The contracting parties shall mutually agree upon the extent of repair overlap if more than five centimeters (two inches) is required.

**5.2.2 Application Temperature:** In general, solvent-borne organic zinc-rich coatings should be applied only at temperatures above 7 °C (45 °F) and relative humidities below 85%. Waterborne products may have other limitations. In all cases, consult the manufacturer's literature for temperature, humidity, and ventilation requirements (see Note 7.4).

**5.2.3 Pot Life:** Multiple component zinc-rich coatings must be applied within the pot life specified by the supplier, and the coating should be continuously agitated during application.

**5.2.4 Film Thickness:** The dry film thickness of the organic zinc-rich coating should be that recommended by the manufacturer. Normally this is between 75 micrometers (3 mils) and 150 micrometers (6 mils). Dry film thicknesses should be measured in accordance with SSPC-PA 2.

**5.2.5 Safety:** Observe all safe handling procedures described in the product material safety data sheet (MSDS) and SSPC-PA Guide 3.

**5.3 TOPCOATING:** If a topcoat is specified, the application of the topcoat should be in accordance with SSPC-PS Guide 8 or the manufacturer's printed instructions.

## 6. Disclaimer

**6.1** This guide is designed to describe, review, or analyze new or improved technology and does not meet the definition of a specification as defined by SSPC. A guide differs from a specification in that it is not suitable for referencing in a contract specification or procurement document.

**6.2** While every precaution is taken to ensure that all information furnished in SSPC guides is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods described herein, or of the guide itself.

## 7. Notes

Notes are not considered requirements of this Guide.

**7.1** Organic zinc-rich primers with the following binders were marketed at the time of this writing: two-component epoxy, epoxy ester, and moisture-curing polyurethane. Other organic binder types have been or may later be marketed.

**7.2** ASTM D 3960 is a commonly used standard practice to determine VOC, but this method may not be acceptable to all jurisdictions. Although ASTM D 3960 does not address analysis of VOC exempt solvents such as PCBTF (parachlorobenzotriflouride), it references two other ASTM Methods which do address exempt solvents, ASTM D 6133 and D 4457. Methods published by government agencies include Bay Area Air Quality Management District (BAAQMD) Method 41 and California Air Resources Board (CARB) Method 310.

**7.3 APPROPRIATE TOPCOATING:** Topcoating will usually provide additional service life to both zinc-rich primers and hot-dip galvanized coating. Topcoats must be formulated not only for environmental resistance, but also for

Provided by : www.spic.ir Licensee: NISOC Library

compatibility with the organic zinc-rich coating, hot-dip galvanizing, or inorganic zinc coating. Generally, topcoating will be required in more severe environments, as recommended by the manufacturer.

**7.4 TEMPERATURE CONSTRAINTS:** Consult the manufacturer of the organic zinc-rich coating to be used concerning service for temperature limitations, especially when the expected exposure is above 66 °C (150 °F).

**7.5 MANUFACTURER'S LITERATURE:** This guide is intended for use to supplement the coating manufacturer's printed instructions and literature.

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC: The Society for Protective Coatings

# TECHNOLOGY UPDATE NO. 1

## Surface Tolerant Coatings for Steel

## 1. Scope

This document defines surface-tolerant coatings and discusses their uses and limitations. It is widely recognized that the application of protective coatings over improperly prepared surfaces is poor painting practice. It is also recognized that proper surface preparation is not always possible or feasible and that the use of surface-tolerant coatings may offer an economical compromise. The types of coatings for specific end uses are dependent on the condition of the substrate. This technology update is for general information purposes only.

## 2. Description and Use

Surface-tolerant coatings may be defined as coatings for substrates that have been prepared for painting to a lesser degree of cleanliness than provided by SSPC-SP 6/ NACE No. 3, "Commercial Blast Cleaning".[1] Surface-tolerant coatings exhibit a greater propensity toward satisfactory service performance than conventional coatings not intended for such applications.

Section 3 is subdivided into narratives for surface-tolerant coating usage, compromised steel substrates, and surface-tolerant coating technologies and their limitations.

## 3. Discussion

**3.1 SURFACE-TOLERANT COATING USAGE:** Surface-tolerant coatings may be selected for many reasons. They are chosen for jobs where less-than-ideal surface cleanliness can be achieved, such as areas where abrasive blasting cannot be performed. Surface-tolerant coatings may be specified for overcoating existing aged coatings. In some instances, this has been done to cover and extend the service life of lead-based paint systems. Due to its geographical location and function, steel may become contaminated with deposits that are difficult to remove. For example, deicing and marine salt deposits may remain on steel even after abrasive blast cleaning.

Sometimes surface-tolerant coatings are specified to reduce overall painting costs by lowering the surface preparation requirements. Although the use of surface tolerant coatings over minimally prepared surfaces will generally reduce performance compared to thoroughly prepared and coated surfaces, proper selection and use of these systems may result in only modest performance reductions. Certain environmental conditions may suggest the need for a surface-tolerant coating. Moisture may be readily deposited on surfaces due to fog, cold wall condensation, and seepage. Painting under these conditions is not recommended, but in some cases may be unavoidable.

SSPC members were surveyed as to the importance of surface-tolerant coatings for various industries. Most industries indicated significant use, with the highest importance noted for bridge, petrochemical, pulp and paper, and utility facilities. Respondents indicated that rust, existing coatings, and soluble salts were the three most frequent applications of surface-tolerant coatings.

**3.2 COMPROMISED STEEL SUBSTRATES:** Surface-tolerant coatings are used on many types of compromised substrates including surfaces with soluble salt, petroleum product, and moisture deposits. Corrosion products and aged coatings are the most common forms of compromised surfaces. Oftentimes multiple contaminants are present. Bridges may have salt deposits, as well as corrosion products, and an existing coating. Petroleum storage facilities may have rusty painted surfaces with oily deposits. Corroded surfaces in industrial atmospheres may be contaminated with ferrous sulfate. Sulfate and chloride deposits are often the limiting factor when painting corroded steel. High concentrations of these contaminants will cause most coatings to fail. (See Section 3.4.)

**3.3 SURFACE-TOLERANT COATING TECHNOLOGIES:** Surface-tolerant coatings may be subdivided into two broad categories: corrosion inhibitive and barrier coatings. Inhibitive coatings are primarily oil-based, alkyd, and water borne acrylic coatings. A wide variety of rust-inhibitive pigments are commercially available. Various mechanisms of corrosion inhibition are postulated for these pigments. Low viscosity in these formulations improves the penetration and encapsulation of corrosion products. Corrosion-inhibitive surface-tolerant coatings are primarily used over existing coatings, corrosion products, and soluble salt contaminants. Some oil and alkyd coatings may be oil tolerant. The performance of inhibitive surface-tolerant coatings is enhanced by the addition of a barrier topcoat.

Barrier coatings work by impeding the transmission of water vapor, oxygen, and ions to the substrate/coating interface.[2,3] Both the binder and the pigmentation are important in achieving good barrier properties. Two component epoxies and urethanes have excellent barrier properties when properly formulated. Lamellar pigments such as aluminum flake, mica, glass flake, and micaceous iron oxide can further improve the performance of surface tolerant coatings by enhancing their barrier properties. Two common surface-tolerant barrier-type coatings that use lamellar pigments are epoxy mastics and moisture cure urethanes.

Provided by : www.spic.ir Licensee: NISOC Library

Barrier coatings are most commonly used over rust, existing coatings, and soluble salt contaminants. Specialized barrier coatings are sometimes used on moist and oily surfaces. Some epoxies are formulated such that small amounts of oil may be absorbed into the coating without seriously impairing performance.[4] Some urethane coatings may be especially tolerant of surface moisture.

Other types of surface-tolerant coatings include penetrating primers, tape coatings, and rust convertors. Penetrating primers are typically unpigmented, low-viscosity, two-component epoxies or urethanes that are used in conjunction with barrier-type topcoats. Tape coatings provide a barrier to moisture and oxygen migration and may also contain corrosion inhibitors. They are typically hand applied with the most common application being corroded piping systems. Rust convertors typically consist of a conversion chemical such as tannic acid combined with an acid-tolerant binder such as a vinyl-type emulsion.[5] The acid component stabilizes the corrosion products and the binder forms a film. Rust convertors are usually topcoated with a barrier coating.

**3.4 LIMITATIONS OF SURFACE-TOLERANT COATINGS:** The performance limitations of surface-tolerant coatings are not always well recognized within the industry. Premature failures attributed to surface-tolerant coatings are more often the result of unrealistic expectations. High levels of surface contaminants, incompatible or poorly adherent aged coatings, and severe exposure environments all contribute to early coating failure. State-of-the-art characteristics of surface-tolerant coatings indicate that most are compatible with specific contaminants and are not necessarily tolerant to a combination of contaminants.

Excessively high concentrations of soluble salts can result in premature coating failure. Research has shown that concentrations greater than 500 mg/m$^2$ of chloride or 1000 mg/m$^2$ of sulfate are associated with blistering and premature coating failure.[5] Maximum recommended permissible concentrations vary considerably for chloride (10-500 mg/m$^2$) and sulfate (100-1000 mg/m$^2$) contamination.[2] Coating performance will be improved by the use of water to remove salt contaminants. Water jetting has been shown to remove iron sulfate more rapidly and completely than grit blasting.[6] Wet blasting techniques both with and without abrasive are more efficient at removing soluble contaminants.

Excessive amounts of water and oil are not easily displaced, absorbed, or transmitted through the film by surface-tolerant coatings and may cause premature coating failure. Some water-tolerant coatings displace water from the substrate and allow the water to pass through the film and evaporate into the air. This is accomplished with hydrophilic solvents and polymers that can displace water effectively. Moisture on the surface or in the pores of the rust will react with the polyisocyanate in the coating. Excess moisture, however, can cause excessive carbon dioxide to be released, causing pinholing, bubbling, and foaming of the urethane film. Higher film thicknesses of the urethane film may further aggravate this problem. Oil-tolerant coatings are comprised of polymers, which are compatible with oil yet can produce a hard-wearing, resilient coating. Some coatings absorb the oil into the film, forming a gel, while others absorb and pass the oil through the coating. Pooled and visible moisture should be wiped dry with clean rags to the greatest extent possible. Visible oil deposits should be absorbed or solvent cleaned to the extent practicable prior to painting.

Grease deposits are perhaps the most difficult contaminant to paint. Generally, grease cannot be absorbed or displaced by the coating. Painting over grease will impair adhesion and film integrity and should be avoided. Grease deposits should be removed by solvent cleaning prior to painting.

Loose rust and pack rust (rust that has accumulated in joints or crevices) are incompatible with good performance. Rusted substrates should be hand tool cleaned to a tight rust at a minimum. Surface-tolerant coatings should not be applied over loose rust or pack rust.

Much has been written about the overcoating of existing coating systems. This is a particularly popular approach for delaying the removal of hazardous lead-based paints. Overcoating is also employed as a means of upgrading OEM coatings. The primary concern in using surface-tolerant coatings for these applications is coating compatibility. The existing coating must not be lifted or excessively softened by the solvents in the surface-tolerant coating. Strong solvents found in some surface-tolerant coatings such as epoxies and urethanes may cause the existing coating system to fail. In the case of aged coatings, this may be especially pronounced. Good intercoat adhesion between the surface-tolerant coating and the aged or OEM coating is necessary. Refer to ASTM D 5064, “Standard Practice for Conducting a Patch Test to Assess Coating Compatibility.” Surface preparation may also affect the performance of the overcoated system. Methods that may disrupt the adhesion of the existing coating to the substrate should be avoided. Brush-off blasting of existing aged coatings has been implicated in the premature failure of surface-tolerant overcoat systems.[7] Excessive shrinkage of the overcoat may also result in adhesive failure of the old coating. Proper coating selection and the application of test patches prior to overcoating will help prevent premature failures.

Severe exposure environments may also contribute to the early failure of surface tolerant coatings.[1] Situations to avoid include high temperature, frequent or continuous immersion, and exposure to corrosive chemicals.

The name “surface-tolerant coating” implies a certain level of comfort or forgiveness when these coatings are used. While tolerant of relaxations from ordinarily rigorous surface cleanliness requirements, surface-tolerant coatings should be specified with due diligence, as their use is dictated by surface conditions that are known to cause

Provided by : www.spic.ir Licensee: NISOC Library

coating failures. While they are tolerant of surface conditions of which ordinary coatings are not, surface-tolerant coatings also have their practical limits in use.

## 4. Disclaimer

This technology update is for information purposes only. It is neither a standard nor a recommended practice. While every precaution is taken to ensure that all information furnished in SSPC technology updates is as accurate, complete, and useful as possible, SSPC cannot assume responsibility or incur any obligation resulting from the use of any materials, paints or methods described herein, or of the technology update itself.

## 5. References

[1] Kapsanis, K. A., Appleman, B. A., "Myths and Realities of Surface-Tolerant Coatings for Bridges," Journal of Protective Coatings and Linings, January, 1992.

[2] Thomas, N. L., "The Protective Action of Coatings on Rusty Steel," Journal of Protective Coatings and Linings, December, 1989.

[3] Hare, C. H., "Barrier Coatings," Journal of Protective Coatings and Linings, February,1989.

[4] Masciale, M., "Coatings Compatible with Moist, Oily, Rusty Surfaces," Journal of Protective Coatings and Linings, May, 1988.

[5] Bagchi, D., "Coatings for Rusted Steel," Journal of Protective Coatings and Linings, September, 1991.

[6] Morcillo, M., et al, "Some Observations on Painting Contaminated Rusty Steel," Journal of Protective Coatings and Linings, September, 1987.

[7] Kline, E., and Corbett, W. D., "Beneficial Procrastination: Delaying Lead Paint Removal Projects by Upgrading the Coating System," Journal of Protective Coatings and Linings, March, 1992.

Provided by : www.spic.ir Licensee: NISOC Library

## Informational Report and Technology Update

# Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment

This NACE International (NACE)/Steel Structures Painting Council (SSPC) report represents a consensus of those individual members who have reviewed this document, its scope, and provisions. Its acceptance does not in any respect preclude anyone, whether he has adopted the report or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not in conformance with this report. Nothing contained in this NACE/SSPC report is to be construed as granting any right, by implication or otherwise, to manufacture, sell, or use in connection with any method, apparatus, or product covered by Letters Patent, or as indemnifying or protecting anyone against liability for infringement of Letters Patent. This report should in no way be interpreted as a restriction on the use of better procedures or materials. Neither is this report intended to apply in all cases relating to the subject. Unpredictable circumstances may negate the usefulness of this report in specific instances. NACE and SSPC assume no responsibility for the interpretation or use of this report by other parties.

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

CAUTIONARY NOTICE: The user is cautioned to obtain the latest edition of this report. NACE/SSPC reports are subject to periodic review, and may be revised or withdrawn at any time without prior notice. NACE and SSPC require that action be taken to reaffirm, revise, or withdraw this report no later than ten years from the date of initial publication.

Approved February 1997

©1997, NACE International and SSPC

NOTICE TO THE READER: The NACE and SSPC releases of this publication contain identical wording in the same sequence. Publication format may differ.

Steel Structures Painting Council
40 24th St.
Pittsburgh, PA 15222
+1 (412)281-2331

NACE International
P.O. Box 218340
Houston, TX 77218-8340
+1 (281)492-0535

Printed by NACE International

Provided by : www.spic.ir Licensee: NISOC Library

## Foreword

This state-of-the-art report covers the design, installation, and maintenance of polymeric coating systems that are applied and directly bonded to concrete in secondary containment applications. This report is intended to inform manufacturers, specifiers, applicators, and facility owners who are required to contain chemicals and/or protect concrete in these applications.

Concrete is used in secondary containment structures because it is a cost-effective material if properly designed and installed. A chemical-resistant coating is often applied to the concrete to extend the service life of the secondary containment structure and properly contain the chemicals.

Numerous recommended practices, specifications, guides, conference proceedings, books, and technical papers have been published by NACE, SSPC, and other organizations covering the many aspects of coatings for concrete. This report focuses on those aspects of the design, materials, and procedures that are specific to coatings for concrete in secondary containment applications, making reference to other publications when appropriate. While there are numerous successful commercial products and designs for containment of chemicals, this report focuses on concrete structures that are coated with thermoset polymer coating systems. Other potentially effective containment systems, such as acid-resistant brick and thermoplastic liners, are not described in this report.

Coatings used in secondary containment applications are also called linings, lining systems, or protective barrier systems; however, for simplicity they will be referred to as coatings or coating systems in this report.

This technical committee report was drafted by NACE Task Group T-6H-52, a subcommittee of T-6H on Coating Materials for Atmospheric Service. NACE/SSPC Joint Task Group H* completed the report, which is published by NACE International under the auspices of Group Committee T-6 on Protective Coatings and Linings and by the Steel Structures Painting Council.

## Contents


Section 1: Regulations ..... 2
Section 2: Service Conditions ..... 3
Section 3: Concrete ..... 4
3.1 Concrete Design for New Structures ..... 4
3.2 Existing Concrete Structures ..... 8
3.3 Surface Preparation ..... 11
Section 4: Coating System Design Requirements ..... 13
4.1 General ..... 13
4.2 Chemical Resistance ..... 13
4.3 System Physical Properties and Stress Considerations ..... 13
4.4 Permeability ..... 14
4.5 Adhesion ..... 14
4.6 Thermal Effects ..... 14
4.7 Design Details ..... 16
4.8 Other Design Factors ..... 21
4.9 System Compatibility Testing ..... 22
Section 5: Coating Systems ..... 23
5.1 General ..... 23
5.2 Polymer Types ..... 23
5.3 Reinforcement and Fillers ..... 25
5.4 Other Formulation Components ..... 26
5.5 Alternative Systems ..... 26
Section 6: Coating System Installation ..... 27
6.1 Concrete Cure and Surface Preparation ..... 27
6.2 Patching of Concrete Surface Imperfections 27
6.3 Priming ..... 28
6.4 Coating System ..... 28
6.5 Testing and Inspection ..... 30
Section 7: Maintenance ..... 31
7.1 Spill Cleanup ..... 31
7.2 Inspections ..... 31
7.3 Repairs ..... 31
Section 8: Safety ..... 31
Section 9: Glossary of Terms ..... 32
References ..... 34
Appendix A—Chemical Conditions ..... 42
Appendix B—Physical Conditions ..... 45
Appendix C—Examples of Chemicals Within Each Type ..... 46


## Section 1: Regulations

1.1 The objective of regulations on secondary containment is to prevent migration of hazardous materials into the soil, ground water, and surface water. In the United States numerous federal, state, and local regulations specifically address the containment of hazardous materials.[1-7] The Resource Conservation and Recovery Act (RCRA)[2] is a primary example of the applicable regulations that refer to containment of hazardous wastes.

1.2 Regulations on secondary containment usually require that the systems:[3]

(1) prevent migration of hazardous (regulated) materials;
(2) have a sound substrate;

*Chairman Fred S. Gelfant, Stonhard Inc., Maple Shade, NJ.

Provided by : www.spic.ir Licensee: NISOC Library

(3) be constructed of or lined with materials that are compatible with the hazardous (regulated) materials;
(4) be free of cracks or gaps; and
(5) contain the capacity of the largest tank.

## Section 2: Service Conditions

2.1 The exposure of secondary containment systems to various chemicals and physical conditions is usually considered in the selection and design of the system. This section discusses the classification of exposure conditions. Appendices A and B list generic coating systems that have been successfully used in each exposure classification.

2.2 Chemicals

2.2.1 Classification by Type

Most acids and alkalis attack concrete; coatings are used to protect the concrete from attack. Most solvents and hydrocarbons do not attack concrete; however, they are classified as hazardous materials, and existing regulations require that they be contained.[3]

Chemicals can be classified by specific types and concentrations to rate the resistance of coatings to chemicals. Typically, chemicals within a specific class attack polymers in a similar manner. For acids and alkalis (with some exceptions), the higher the concentration, the more aggressive the attack. With solvents, the closer the solvent is to the solubility parameter of the coating, the more prone that coating is to swelling by permeation of that solvent. In addition, the lower the molecular weight of the solvent, the more rapidly it diffuses into the coating.

Mixing some chemicals reduces their aggressiveness to coatings (e.g., mixing acids with alkalis), assuming that the exotherm from the mixing does not cause thermal damage. (Potential thermal damage from exotherm is ignored.) Mixing other chemicals significantly increases their aggressiveness. For example, mixtures of acids and solvents or mixtures of two or more solvents are commonly used as paint strippers.

2.2.2 The chemical types used in Appendix A include:

(1) inorganic acids
(2) organic acids
(3) oxidizers and oxidizing acids
(4) alkalis
(5) chlorinated solvents
(6) oxygenated solvents
(7) hydrocarbon solvents
(8) salt solutions
(9) pesticides and herbicides

Examples of typical chemicals within each type are given in Appendix C.

2.2.3 Classification by Concentration

2.2.3.1 Most acids and alkalis are further classified by concentration, usually percent by weight in water. When a polymer in a coating is susceptible to attack by a specific chemical, a higher concentration of that chemical is usually more aggressive to the coating (sodium hydroxide is one notable exception). Where a known concentration of a specific chemical is to be contained, compatibility is determined by testing the resistance of the coating to that concentration of the chemical.

2.2.3.2 Evaporation, solidification, and mixing can modify the aggressiveness of a specific chemical. Many acids or alkalis will become more concentrated due to evaporation if they are spilled at a low concentration on a coating and not cleaned immediately. The higher concentrations are potentially more aggressive toward the coating. Some chemicals are spilled in the liquid state but solidify at ambient temperature, thus reducing their mobility and aggressiveness.

2.2.3.3 The concentration classifications used in Appendix A vary depending on the chemical type. For acids and alkalis, Appendix A follows the common practice of listing resistance to a dilute concentration (usually up to 10%, in water), a medium concentration (usually above 10%), and a concentrated level (the highest commonly used concentration). For solvents, Appendix A lists only the resistance to the concentrated (undiluted) level.

2.2.4 Frequency and Duration of Contact

2.2.4.1 For coatings that are suitable for continuous and long-term exposure to a chemical (i.e., suitable for immer-

Provided by : www.spic.ir Licensee: NISOC Library

sion exposure or primary containment), frequency and duration of contact with the chemical is not a concern; however, for aggressive chemicals that will degrade a specific coating system, determining the frequency and duration of contact is important. Many factors can affect the actual exposure of the coating to the chemicals that are to be contained. These include spill frequency, spill amount, time until dilution or cleanup, effectiveness of dilution or cleanup, and temperature of the spill (see 2.2.5).

2.2.4.2 The exposure classifications used in Appendix A are 72 hours and continuous. The 72-hour classification applies to secondary containment areas subject to spills that are cleaned as soon as they are detected. The 72-hour chemical resistance requirement is often adopted for areas where spills may not be detected until after one whole weekend. The 72-hour classification is also applied to areas that are not subject to spills but are designed to contain chemicals after catastrophic failure of a primary containment tank. The continuous classification is for areas that are subject to continuous spills or areas where spills are not cleaned.

2.2.5 Surface Temperatures

2.2.5.1 Although spills from process chemicals may initially be at temperatures above ambient, these spills usually cool to ambient conditions in a relatively short period of time. Catastrophic tank failure for a chemical stored above ambient temperature is one exception. Increases in temperature caused by diluting and/or neutralizing concentrated acids and alkalis could affect the maximum temperature to which the coating is exposed.

2.2.5.2 The surface temperature classifications used in Appendix A include ambient temperatures (up to 40°C [104°F]), elevated temperatures (40°C to 70°C [104°F to 158°F]), and high temperatures (70°C to 100°C [158°F to 212°F]). These classifications are important because coatings used in secondary containment may deteriorate rapidly when exposed to chemicals at elevated or high temperatures.

2.3 Physical Conditions

2.3.1 Ambient Environment

2.3.1.1 When classifying the ambient environment to determine the exposure and suitability of a coating system, important factors include the temperature range (maximum and minimum surface temperature), the rate of temperature changes (i.e., daily due to ambient temperature swings or sudden due to thermal shock from chemical spills), and sunlight exposure.

2.3.1.2 The ambient temperature ranges used in Appendix B are as follows: low-temperature range (22°C ± 10°C [72°F ± 50°F]), which includes most indoor and controlled environments; medium-temperature range (22°C ± 20°C [72°F ± 68°F]), which includes most indoor areas without temperature control and some outdoor, covered areas; wider-temperature range (22°C ± 30°C [72°F ± 86°F]), which includes most outdoor environments; and extreme-temperature range (22°C more than ± 30°C [72°F more than ± 86°F]), which includes severe hot or cold outdoor environments.

2.3.2 Traffic Conditions

The traffic condition classifications used in Appendix B include:

(1) occasional foot traffic
(2) constant foot traffic
(3) fork lift
(4) drum storage
(5) process area
(6) tank storage
(7) heavy traffic (tanker trucks, steel-wheeled vehicles)

## Section 3: Concrete

3.1 Concrete Design for New Structures[8-11]

Proper concrete design and installation practices are required to ensure the performance and success of the concrete as the substrate of the secondary containment system.

3.1.1 Concrete Properties

Provided by : www.spic.ir Licensee: NISOC Library

Describing specific raw materials and mix designs for concrete is beyond the scope of this report. These topics are adequately covered in numerous American Concrete Institute documents.[1] It is important to know the desired properties of the finished concrete structure and concrete surface and how they affect the coating to be applied. The properties of concern, the factors that affect these properties, and common specifications are given in the following paragraphs.

3.1.1.1 Strength

3.1.1.1.1 Compressive strength provides a rigid structural base for the coating. Tensile strength provides adequate adhesion between the coating system and the concrete. Tensile and shear strength ensure the concrete survives the stresses applied by the curing coating on the concrete. Tensile and flexural strength resist cracking in the concrete during curing and drying of the concrete and during thermal cycling.

3.1.1.1.2 In addition to installation, finishing, and curing practices, the strength of concrete is affected by the type of cement, the amount of cement in the mix, the water-to-cement ratio, and the air content. According to ACI 209,[12] the tensile strength of concrete ranges from 6 to 8% of the compressive strength. For secondary containment, ACI 350.2R[10] recommends a minimum of 28 MPa (4,000 psi) compressive strength and 1.7 MPa (250 psi) tensile strength at 28 days after concrete placement. The following mix design is typical for achieving these values:

(1) cement content: 200 kg/m$^3$ (600 lb./yd) minimum,
(2) water-to-cement ratio: 0.45 maximum,
(3) air content (depends on geographical location): 4 to 8%.

3.1.1.2 Strength Development

The rate at which concrete develops strength is important for scheduling coating application. According to ACI 209, strength development is a function of cement type, 28-day design compressive strength, temperature, and time. As described in ACI 305R[13] and ACI 306R,[14] the early rate of strength development increases with increased temperature; however, the ultimate strength achieved is lower for concrete that is placed at elevated temperatures. ASTM[2] C 150[15] Type III cement or accelerators are used where rapid strength development is required, but often at the unwanted expense of increased shrinkage. Strength development is slower for ASTM C 150 Type II and Type V cements.

3.1.1.3 Surface Strength

Surface strength enables the concrete to remain intact during surface preparation. It also helps to maintain adequate adhesion between the coating system and the concrete when subjected to stress from curing of the coating, thermal movement, and physical abuse. Surface strength is a function of the concrete design strength, segregation, and the cure at the surface. Segregation reduces surface strength and can be caused by too much vibration during placement or excessive finishing and can result in a high water-to-cement ratio or an excess of fine aggregate at the surface. Surface strength depends on the normal concrete cure parameters described in Paragraph 3.1.1.1, plus the added variable of how long the surface is kept moist. Concrete based on ASTM C 150 Type I cement reaches 50% of 28-day strength if the surface is not kept moist, 80% if the surface is kept moist for three days, and full 28-day strength if the surface is kept moist for seven days. Concrete based on ASTM C 150 Type III cement reaches full 28-day strength if kept moist for three days.[16]

3.1.1.4 Surface Imperfections and Porosity

Defects such as surface voids, tieholes, bugholes, pinholes, and excess porosity may affect the application or performance of the coating. Protrusions such as

[1] American Concrete Institute (ACI), 38800 International Way, Country Club Drive, Farmington Hills, MI 48331.
[2] American Society for Testing and Materials (ASTM), 100 Barr Harbor, West Conshohocken, PA 19428-2959.

Provided by : www.spic.ir Licensee: NISOC Library

form lines, fins, sharp edges, and spatter may cause holidays or thin sections in the coating if they are not removed. Most defects are caused by placement and finishing techniques, although excess porosity is usually the result of excess moisture or insufficient surface curing. Most defects and deficiencies can be avoided by proper mix design, installation procedures, and curing. Surface deficiencies are usually addressed during surface preparation or when patching the surface prior to coating (see Paragraphs 3.2.3, 3.3.2, and 6.2).

3.1.1.5 Uniformity

Concrete uniformity depends on correct mixing, placing, and finishing. Defects such as honeycombs and rock pockets, usually caused by insufficient vibration or insufficient fluidity to the mix, do not provide a sound substrate for coatings. Segregation may result in surface cracking (see Paragraph 3.1.1.3).

3.1.1.6 Shrinkage

3.1.1.6.1 Shrinkage can cause cracking, curling, and excessive joint movement in a concrete structure and can cause plastic shrinkage cracking at the surface of a slab. Predicting and controlling shrinkage is important, particularly if the coating is applied soon after placement. According to ACI 209, shrinkage in concrete using Type I cement that is kept moist for seven days can range from 415 to 1,070 x $10^{-6}$ m/m (in/in). Approximately 40% of the shrinkage occurs in the first 28 days and 90% in the first year.

3.1.1.6.2 Shrinkage can be affected by:

(1) cement type (The cement types, listed in order from the most shrinkage to the least shrinkage, are as follows: ASTM C 150 Type III; ASTM C 150 Type I; ASTM C 150 Type II; and ASTM C 845[17] Type K);
(2) aggregate type, size, and shape (smaller aggregates may increase shrinkage);
(3) mix and cure temperature (higher temperature increases shrinkage);
(4) cure accelerators (may increase shrinkage); and
(5) water content (more water increases shrinkage).

3.1.1.6.3 Water content is the most important factor. Curling, plastic shrinkage cracking, and low surface strength occur when the surface dries too rapidly. Common practices for reducing problems due to shrinkage include minimizing water levels in the concrete mix, ensuring sufficient moisture levels at the surface during cure, and placing joints correctly. Coating applicators can expect additional movement at the joints when they are coating a concrete substrate early in its shrinkage history.

3.1.1.6.4 ACI 223[18] describes the use of ASTM C 845 Type K cement. Type K cement reduces shrinkage during cure, but it also reduces strength and slows strength development.

3.1.2 Structure Design

Any coating system that is bonded to a concrete substrate depends on the concrete for its structural integrity. Details concerning the design of concrete structures are beyond the scope of this report; they are addressed in numerous ACI reports, including ACI 302.1R,[8] ACI 350R,[9] and ACI 350.2R[10]. The range of service conditions and exposures in secondary containment areas varies widely, affecting the priority of specific design considerations. Design guidelines range from standard floor construction for light service conditions (ACI 302) to specialized design for primary containment (ACI 350). The effects of shrinkage, loading, and thermal movement are considered and accommodated in the design of the joints, reinforcement, slab thickness, and concrete mix. The size of the containment structure, which is usually governed by regulations, and the proper slope to facilitate drainage are also important design considerations.

3.1.3 Joints

3.1.3.1 ACI 302, ACI 350, ACI 504R[19] and ACI 224R[20-22] give recommendations on the location and design of joints for concrete structures. Joints are usually categorized as either contraction (control) joints or isolation (expansion)

Provided by : www.spic.ir Licensee: NISOC Library

joints. Contraction joints are designed to accommodate in-plane drying shrinkage and thermal movement. Isolation joints are designed to isolate abutting but separate structural sections, such as supporting walls, tank pads, and columns. Good concrete design practice includes cutting the contraction joints in square patterns early in the cure—before random shrinkage cracking—to a depth of at least one-fourth of the slab thickness.

3.1.3.2 For floors, ACI recommends that the maximum distance in meters between joints be equal to 24 to 36 times the slab thickness in meters (the maximum distance in feet between joints would be equal to two to three times the slab thickness in inches). To minimize stress on the coating, shorter distances between joints (as low as 4 m [12 ft]), in conjunction with placing or cutting joints where stresses are anticipated (e.g., at corners, around tank foundations, and at slab intersections), have been used. Alternatively, highly reinforced structure designs have been used that reduce the reliance on joints.[9]

3.1.4 Hydraulic and Hydrostatic Pressures

The movement of moisture in concrete throughout the curing process and after application of the coating is an important design consideration. Pressure due to moisture from drying of the concrete or from ground water may be substantial; in some instances, the pressure may be sufficient to disbond barrier coating systems that appear to be well bonded. These pressures are commonly referred to as hydrostatic, capillary, and osmotic pressures.[23-25] Hydrostatic forces through structures may affect bonded coating systems at cracks or joints in the concrete. Capillary and osmotic forces are difficult to predict and are potentially significantly higher than hydrostatic forces. In most cases, a vapor barrier (or positive-side waterproofing) is installed under the concrete slab to prevent subsurface moisture from permeating the slab.

The inherent free moisture content of concrete is 3 to 6%. Moisture in excess of this level evaporates from the concrete. Concrete is usually placed with more water than is needed to completely hydrate the cement. One reason for waiting 28 days prior to coating concrete with a barrier system is to allow this excess moisture to evaporate (see Paragraph 6.1). This waiting period is especially important if a vapor barrier (or positive-side waterproofing) is installed because the barrier does not allow moisture to exit into the ground.

3.1.5 Concrete Finishing and Surface Characteristics

3.1.5.1 In addition to mix design, surface cure, and surface preparation, the method used to finish concrete surfaces has a significant effect on the properties of the concrete surface. The typical profile, porosity, and strength of various finished concrete surfaces are shown in Table 1. The coating system depends on these surface characteristics for adhesion.

3.1.5.2 No preferred method for finishing concrete to accept coatings has been established by the concrete coatings industry. The surface cure, surface preparation method, and type of coating system to be applied can greatly influence the effectiveness of a concrete finishing method. For example, broom finishing is sometimes used because it gives a profile for the coating; however, most of the profile may be removed during surface preparation. When sacking (grout rubbing) is used to fill voids in formed concrete surfaces, subsurface voids are created; the added cement is usually removed during surface preparation due to improper cure of the added cement paste. Using a metal-trowel is gaining acceptance as the preferred finishing method for horizontal surfaces, providing the surface is not excessively trowelled, the concrete is properly cured, and the laitance is removed prior to coating.

3.1.6 Concrete Cure

3.1.6.1 Maintaining sufficient moisture and proper temperature in concrete in the early stages of cure is important to ensure development of the designed strength. Keeping the surface moist until sufficient strength has developed at the surface is important to ensure development of sufficient surface strength, to reduce curling, and to reduce surface cracking.[11,13,14,16,27,28]

3.1.6.2 ACI 308[16] recommends seven days of moist curing for ASTM C 150 Type I portland cement-based concrete and three days for ASTM C 150 Type III portland cement-based concrete, if the temperature is above 10°C (50°F). ACI

Provided by : www.spic.ir Licensee: NISOC Library

308 also describes numerous methods to properly cure concrete, including the use of sealing materials and other methods to keep concrete moist.

**TABLE 1**
**Typical Surface Properties of Finished Concrete[26]**

| Method | Profile | Porosity[(A)] | Strength[(A)] | Problems |
|---|---|---|---|---|
| Formed concrete | Smooth to medium | Low to medium | Medium | Voids, protrusions, release agents |
| Wood float | Medium | Medium | Medium | |
| Metal trowel | Smooth | Low | High | |
| Power trowel | Smooth | Very low | High | Very dense |
| Broom finish | Coarse to very coarse | Medium | Medium | |
| Sacking | Smooth | Low to medium | Low to high[(B)] | Weak layer if not properly cured |
| Stoning | Smooth to medium | Low to medium | Low to high[(B)] | Weak layer if not properly cured |
| Concrete block | Coarse to very coarse | Very high | Medium | Pinholes |
| Shotcrete[(C)] | Very coarse | Medium | Medium | Too rough for thin coatings |

[(A)] These surface properties are based on similar concrete mix, placement, and vibration, and are prior to surface preparation.
[(B)] Strength depends on application and cure.
[(C)] Shotcrete may be refinished after placement, which would change the surface properties shown in this table.

3.1.6.3 ACI 305 and ACI 306 describe the effects of hot and cold temperatures on concrete curing. Knowing the time required for adequate surface cure is essential for determining when coating application may begin (see Paragraph 6.1).

3.1.7 Sealers and Curing Membrane Compounds

Sealers and curing membrane compounds are commonly used to improve surface cure and to reduce moisture loss immediately after placement and finishing of concrete surfaces. Materials and practices are described in ACI 308 and ASTM C 309.[29] Commonly used curing membrane compounds (some of which also perform as sealers after the concrete has cured) include synthetic resins, waxes, and acrylic-based materials. Many of these materials are incompatible with thermoset coatings and are difficult to remove. Paragraph 3.2.6 describes a method for testing sealers for compatibility with coating materials and ease of removal.

3.2 Existing Concrete Structures

Concrete structures more than one year old can be characterized more easily than new concrete structures because strength, surface strength, shrinkage, and moisture content have stabilized. After one year—with the exception of years with mild winters—the structure has been exposed to a complete thermal range. Other than structural problems (which are beyond the scope of this report), after one year most movement and cracking from shrinkage and thermal cycling is evident and can be treated appropriately in the coating system design. However, existing structures may have been subjected to physical abuse or chemical contamination that needs assessment and repair prior to application of a coating.[30,31]

3.2.1 Surface Strength

3.2.1.1 Requirements

The minimum requirement for surface strength depends on the service conditions and coating system (see Sections 2.3 and 5.2). As stated in Paragraph 3.1.1.3, adequate surface strength ensures that the concrete structure remains intact during surface preparation

Provided by : www.spic.ir Licensee: NISOC Library

and ensures that the bond to the coating is sufficient to survive stresses from curing and thermal cycling. Many coating manufacturers and designers typically specify minimum bond strength between 1.4 and 2.1 MPa (200 to 300 psi), depending on the coating and the service conditions.

3.2.1.2 Test Methods[32]

3.2.1.2.1 ASTM D 4541[33] is typically used to test for surface strength.

3.2.1.2.2 ACI 503R, Appendix A,[34] uses a larger test area than ASTM D 4541.

3.2.1.2.3 The patch test involves applying the coating to a 100- to 150-mm (4- to 6-in.)-diameter area of the concrete after surface preparation, typically by the same application method as will be used to coat the entire structure. After 24 hours, the concrete/coating interface is tested by striking the side of the patch with a hammer or a hammer and chisel. Although the patch test is not quantitative, it is simple and easy, requires no special equipment or adhesives, shows potential adhesion of the specific coating to be used, and tests surface strength in a shear mode.

3.2.2 Physical and Chemical Damage

Existing concrete structures that have been subjected to mechanical damage (due to impact or abrasion), chemical attack, or rebar corrosion are restored to provide a uniform, sound substrate for coating. In cases of severe damage, the concrete may need to be completely removed and replaced. It is important to remove all deteriorated concrete and to cut the surrounding sound concrete using the procedures described in ICRI[(3)] 03730[35] in order to best receive and hold the patching material. Some contaminants may have a detrimental effect on the rebar or the applied coating if they are not completely removed. Methods for detecting and treating residual chemical contamination are discussed in Paragraph 3.3.1. Cementitious repairs are treated as new concrete (see Paragraph 3.1). Polymeric grouts and patching materials are often used, especially when the coating is to be applied immediately after the repair. It is important that these materials be compatible with he coating to be applied. Selection and application of these materials is described in Paragraph 6.2.

3.2.3 Other Defects and Imperfections

3.2.3.1 Defects such as honeycombs, scaling, and spalling do not provide a sound, uniform substrate for the coating. Defects are usually removed and patched prior to surface preparation (see Paragraph 6.2).

3.2.3.2 Surface voids, tieholes, bugholes, pinholes, and excess porosity may affect the application and performance of the coating. The maximum substrate void size or porosity that can be tolerated depends on the type of coating. These voids typically are filled prior to coating application (see Paragraph 6.2). If voids are not filled and the coating is applied, the trapped air vapor expands and contracts and may affect the cure or the film integrity and performance of the coating. Excessive porosity in the concrete surface may result in pinholes.

3.2.3.3 Protrusions such as form lines, fins, sharp edges, and spatter may cause holidays or thin sections in the coating if they are not removed. Protrusions and rough edges typically are removed during surface preparation.

3.2.4 Joints and Cracks

Many coatings are rigid and are prone to reflective cracking (see Paragraph 4.7.1). Therefore, it is important to identify existing joints and cracks and quantify the maximum expected movement prior to coating selection. Movement at joints or cracks is due to shrinkage, thermal cycling, settling, or load; however, in existing structures no significant movement is expected due to shrinkage.[20-22] Additional information about the identification of joints and their expected movement is given in ACI 302, ACI 504, and in Paragraph 3.1.3 of

(3) International Concrete Repair Institute (ICRI), 1323 Shepard Dr., Ste. D, Sterling, VA 22170.



Provided by : www.spic.ir Licensee: NISOC Library

this report. Monitoring joints and cracks over 24 hours helps to determine whether they are static or dynamic. Some cracks are invisible in warm conditions when the concrete is expanded, but they may be visible when temperatures are lower, when the concrete is drying (because the crack dries slower), or when a dye method is used to identify cracks. Joints and cracks that are identified as dynamic are usually treated as described in Paragraph 4.7.1 to prevent reflective cracking in the coating.

Plastic shrinkage cracking is common in concrete when the surface is not cured properly. On existing concrete structures, these cracks can be treated as static cracks; however, the surface strength is probably low due to the improper surface cure (see Paragraph 3.2.1).

3.2.5 Hydraulic and Hydrostatic Pressures

The importance of moisture migration and the effects of ground water and vapor barriers are described in Paragraph 3.1.4. In existing concrete structures, unless the concrete structure has been continuously wet, moisture migration due to drying is not a concern. However, all other issues discussed in Paragraph 3.1.4 apply to both new and existing concrete. It is important to determine whether a vapor barrier is under the existing concrete structure. If no vapor barrier is present, a moisture migration or moisture test can be used to determine whether a moisture problem exists.

3.2.5.1 Moisture Test Methods

The following are some of the common methods used to identify or quantify the free moisture in concrete prior to the application of coatings.[36,37]

(1) ASTM D 4263,[38] Plastic Sheet Method.
(2) RMA Test Method,[39] Calcium Chloride Absorption Rate (RMA test).[(4)]
(3) BS 5325,[40] Appendix A.1, Hygrometer Test (Relative Humidity Method).[(5)]
(4) BS 5325, Appendix A.2, Conductivity Test (Gel Bridge Method).
(5) Calcium Carbide Method.[36]
(6) Capacitance-Impedance Method.[36]

3.2.5.2 Use and Interpretation of Moisture Test Methods

3.2.5.2.1 ASTM D 4263 and the RMA test are commonly used and accepted in the United States. The hygrometer and conductivity tests are cited in numerous British standards and are accepted in the United Kingdom, while the carbide method is accepted in other parts of Europe.

3.2.5.2.2 All of these methods are quantitative except for ASTM D 4263. The plastic sheet, RMA, and capacitance-impedance methods are nondestructive, while the hygrometer, conductivity, and calcium carbide methods involve drilling into the concrete.

3.2.5.2.3 Testing duration is 16+ hours for ASTM D 4263, 72 hours for the RMA method, and from 4 to 72 hours for the hygrometer test. The other methods give results immediately if the testing equipment has been calibrated.

3.2.5.2.4 The plastic sheet method may indicate if excess moisture is present at the time of the test. However, because the method depends on a moisture differential—a higher relative humidity in the concrete than in the air above the concrete surface—during the test span, potential problems are not always evident at the time the test is performed.

3.2.5.2.5 The coating manufacturer can provide information on the tolerance of a specific coating system for free water or moisture migration. A free water content of less than 5% by weight is acceptable for most coatings. Alternatively, concrete relative humidity of less than 80% or moisture transmission rates of less than 15 g/24 hr/$m^2$ (3 lb/24 h/1,000 $ft^2$) have proved acceptable for most coatings.[36]

---

(4) Rubber Manufacturers Association (RMA), 1400 K St. NW, Ste. 900, Washington, DC 20005.
(5) British Standards Institution (BSI), Two Park St., London, WIA 2BS, United Kingdom.

Provided by : www.spic.ir Licensee: NISOC Library

3.2.5.2.6 Occasionally, despite moisture testing, a problem is not identified until after an impermeable coating is applied.

3.2.5.3 Retrofit Repair

Negative-side barrier systems, grouting with high-density cementitious products, and penetrating sodium or potassium silicate sealers have been used successfully under coatings in some installations, although using a negative-side barrier system is not usually effective. Where practical, well points have been used to relieve the source of hydrostatic pressure.

3.2.6 Existing Sealers and Coatings

Maintaining an adequate bond between the concrete substrate and the coating is important. Existing sealers or coatings on the concrete are tested for compatibility with the coating to be applied. If they are not compatible, the sealers or coatings are removed. Even if the existing coating is found to be compatible by adhesion testing, the surface of the existing coating is abraded to provide adequate surface profile for the coating to be applied.

3.2.6.1 Sealers and Curing Membrane Compounds

Curing membrane compounds (ASTM C 309), sealers, and hardeners (sodium silicate) are often encountered in existing concrete structures. The methods in Paragraph 3.2.1.2 are useful in determining whether the existing material is compatible with the coating to be applied. Sodium silicate can be removed only by abrasive blasting or water blasting, whereas the wax, resin, and acrylic materials can be removed by abrasive blasting, flame blasting, or the use of paint strippers (see Paragraph 3.3).

3.2.6.2 Existing Coatings

The methods in Paragraph 3.2.1.2 are useful in determining whether the existing coating is compatible with the coating to be applied. Procedures for removing existing coatings are discussed in Paragraph 3.3.1.3.

3.3 Surface Preparation

Surface preparation of concrete is covered in documents published by NACE (6F163,[41] 6G166,[42] 6H175,[43] and 6G191[44]), ASTM (C 811[45]), ICRI (Guide No. 03732[46]), NACE/SSPC (work in progress[26]), ACI (515.1R[47]), and in technical articles.[28,48,49]

3.3.1 Contamination

Visible and nonvisible contaminants on new and existing concrete surfaces often impede coating adhesion. Problems caused by surface contaminants that are not removed during surface preparation or by contaminants migrating to the concrete/coating interface could become evident some time after the coating application. Identification and removal of contaminants is covered in detail in NACE 6G191, ASTM D 4258,[50] PCA[(6)] IS214.02T,[51] and in technical articles.[30,31,52,53]

3.3.1.1 Types of Contamination

3.3.1.1.1 Hydrophobic Materials

(1) Form-release agents, including oils, wax, grease, and silicone
(2) Curing membrane compounds and sealers, including waxes and resins
(3) Existing incompatible coatings and adhesives

3.3.1.1.2 Salts and Reactive Materials

(1) Chemicals, including acids, alkalis, and salts
(2) Laitance and efflorescence
(3) Concrete admixtures

3.3.1.1.3 Microorganisms

(1) Fungus, moss, mildew, algae, and other organic growths
(2) Decomposing foods that produce organic acids

3.3.1.2 Tests for Contamination

3.3.1.2.1 Hydrophobic Materials

Hydrophobic materials can be detected by a water drop test.[53]

3.3.1.2.2 Salts and Reactive Materials

(6) Portland Cement Association (PCA), 5420 Old Orchard Rd., Skokie, IL 60077-1083.

Provided by : www.spic.ir Licensee: NISOC Library

Acid, alkali, and sulfate attack leaves a weak surface layer that can be detected using the surface sometimes be detected by testing the pH of the concrete surface. Normal fresh concrete has a pH of 12 to 13, but aged concrete can have a pH at the surface as low as 7 before surface preparation. Salts, including efflorescence, are often visible as a white bloom, colored deposit, or weak surface layer. Salts can be identified by analytical methods, e.g., atomic absorption. Efflorescence is a sign that water is transporting salts from the ground or the concrete to the surface. This problem of moisture migration is discussed in Paragraph 3.2.5. Removal of efflorescence does not solve the moisture migration problem.

3.3.1.2.3 Microorganisms

Organic growths are visible on concrete surfaces. Decomposing foods that produce organic acids can deteriorate concrete.

3.3.1.3 Treatment and Removal

3.3.1.3.1 Hydrophobic Materials

Steam cleaning, flame blasting, and degreasers and absorbents are used to remove oil and grease. The method chosen to remove a coating is usually the least destructive method that is successful. In increasing order of aggressiveness, the methods are: (1) using paint strippers, (2) grinding, (3) wet abrasive blasting, dry abrasive blasting, or high-pressure water cleaning, and (4) water jetting, scarifying, or flame blasting. These methods are discussed in Paragraph 3.3.2.

3.3.1.3.2 Salts and Reactive Materials

Salts and efflorescence can be removed by abrasive blasting, water blasting, or applying a weak acid solution and then water cleaning.[51] Residual acids and alkalis are first neutralized and then removed by water cleaning. If the concrete is deteriorated down to the rebar, see the ICRI Guide.[35]

strength test methods in Paragraph 3.2.1.2 or by various analytical methods. Acidic materials can

3.3.1.3.3 Microorganisms

Fungus, moss, mildew, algae, and other microorganisms are removed by washing with sodium hypochlorite (household bleach) and rinsing with water.[51] High-pressure water cleaning or abrasive blasting may also be used.

3.3.2 Surface Preparation Methods

Table 2 lists typical surface preparation methods with their intended use, profile created, typical problems encountered, and solutions to those problems. Acid etching, which used to be common practice, is now infrequently specified, primarily due to environmental considerations and lack of consistent results.

3.3.3 Quantifying Prepared Concrete Surfaces

The degree of surface preparation needed to achieve good adhesion depends on the requirements of the coating system (see Section 5). The following tests are typically used to determine the properties of prepared concrete surfaces.

3.3.3.1 Surface strength[32] (see Paragraph 3.2.1)

3.3.3.2 Surface profile[26]

Surface profile is quantified by equivalent graded abrasive paper sizes, or, for coarse profiles, by measuring the surface profile in millimeters (mils).

3.3.3.3 Surface cleanliness (see Paragraph 3.3.1)

(1) ASTM D 4258
(2) Dust: black cloth test

3.3.3.4 pH

pH testing is performed to ensure neutralization after surface preparation by acid etching. pH testing has also been used to help detect the presence of acidic or alkaline contaminants.[53]

ASTM D 4260[58]

Provided by : www.spic.ir Licensee: NISOC Library

3.3.3.5 Moisture content[36,37] (see Paragraph 3.2.5.1)

3.3.3.6 The 28-day waiting period (see Paragraph 6.1)

**TABLE 2**
**Surface Preparation Methods[26]**

| Preparation Method | When Used | Profile Created[(A)] | Problems | Solutions |
|---|---|---|---|---|
| Dry abrasive blasting[54] | Removal, profile, cleaning | Fine (150) to extra coarse (40) | -Dust on surface<br>-Airborne dust<br>-Noise | -Vacuum cleaning<br>-Vacuum attachments<br>-None |
| Wet abrasive blasting | Removal, profile, cleaning | Fine (150) to extra coarse (40) | -Wets concrete<br>-Creates sludge | -Let concrete dry<br>-Cleaning |
| High-pressure water cleaning[55,56] | Removal, cleaning | Fine (150) to extra coarse (40) | -Wets concrete<br>-Creates sludge | -Let concrete dry<br>-Cleaning |
| Water Jetting [55,56] | Removal | Rougher than extra coarse | -Creates sludge<br>-Wets concrete<br>-Coarse profile | -Cleaning<br>-Let concrete dry<br>-None[(B)] |
| Impact tools | Removal, profile, cleaning | Rougher than extra coarse | -Airborne dust<br>-Fracturing<br>-Coarse profile | -Vacuum attachments<br>-Other methods<br>-None[(B)] |
| Power tools | Removal | Smooth (no grit equivalent) | -Airborne dust<br>-Fine profile | -Vacuum attachments<br>-Other methods |
| Flame blasting[57] | Removal, profile, cleaning | Rougher than extra coarse | -Excess removal<br>-Damages concrete | -Experience[(B)]<br>-Remove damaged concrete |
| Acid etching[58] | Profile, cleaning | Fine (150) to medium (100) | -HCl is hazardous<br>-Not for vertical or overhead surfaces<br>-Neutralization<br>-Wets concrete<br>-Curing membrane | -Other acids<br>-Other methods<br><br>-pH testing<br>-Let concrete dry<br>-Other methods |

[(A)] Profile is described using standard classifications and screen grit sizes for coated abrasive products. These are typical surface profile values only. Results may vary significantly due to concrete properties and surface preparation practices.
[(B)] May be acceptable for thick coating systems; otherwise, the surface can be patched prior to coating application.

## Section 4: Coating System Design Requirements

4.1 General information on design requirements for coating systems is contained in various ASTM, ACI, and NACE publications[47,59-67] as well as in technical articles.[68-87] Paragraphs 4.2 to 4.8 discuss coating system properties, the importance of these properties, and the variables that affect these properties. Paragraph 4.9 lists the test methods commonly used to quantify coating properties.

4.2 Chemical Resistance

A coating system is designed to survive the anticipated chemical exposure for its entire design life (see Paragraph 2.2). The chemical resistance of a coating depends on the polymer type, cross-link density, cure time and temperature, filler type and amount, coating thickness, and reinforcement.

4.3 System Physical Properties and Stress Considerations

Provided by : www.spic.ir Licensee: NISOC Library

4.3.1 Ignoring stress concentrations at joints, cracks, and corners, continued coating performance depends on many factors, including concrete surface strength, concrete surface profile, coating system strength, coating system elasticity, coating system thickness, coating shrinkage during application, thermal exposure conditions, chemical exposure conditions, and thermal expansion of the concrete and coating.

4.3.2 Structural integrity of the coating and coating adhesion depend on the tensile, flexural, and compressive strength of the coating. Flexibility and toughness enable the coating to withstand strain and forces due to impact or substrate movement. In most thermoset polymer systems there is a direct trade-off between cross-link density, which gives increased strength and chemical resistance, and flexibility, which gives increased ability to bridge cracks. Flexibility and strength are balanced to give optimum performance.

4.4 Permeability

4.4.1 Low water vapor transmission (WVT) of coatings applied to steel in primary containment is critical in preventing corrosion of the steel substrate. However, concrete substrates do not corrode from water vapor. The WVT of a coating for concrete is simply an indicator—not always a good one—of the coating's ability to protect the concrete from corrosive materials and to protect the environment from hazardous materials.

4.4.2 Results of WVT tests do not correspond to the transmission resistance of the coating to solvents or solvent vapors. The permeability of a coating when exposed to a specific solvent is a function of the solubility parameters of the solvent and the coating, the molecular size of the solvent, the cross-link density of the polymer, and the type and amount of filler in the coating. The coating can be tested for weight gain after immersion in a solvent to indicate the relative permeability of the coating in that specific solvent. The WVT and permeability of coatings are reduced by increased film thicknesses, increased cross-link densities in the polymer, and the use of fillers.

4.4.3 One U.S. federal regulation has specified a maximum WVT of $1 \times 10^{-7}$ cm/s (3.4 g/h-$m^2$) (4.9 grains/h-$ft^2$) for secondary containment systems.[88] This level is based on 15 L (4 gal) of water per day for an uncoated 200-$m^2$ (2,000-$ft^2$) concrete slab with all cracks sealed. Most coating systems, depending on their thickness, meet this criterion, even when the WVT of the concrete is ignored. While a coating system may meet the WVT criterion, the amount of water that passes through the coating during WVT lab testing may be insignificant when compared to the relative effect of pinholes and cracks in the field-applied coating system (see Paragraph 4.7.1). New York state regulations specify a maximum transmission level of $1 \times 10^{-6}$ cm/s (34 g/h-$m^2$) (49 grains/h-$ft^2$) for the chemical to be contained.[89] However, no approved test method currently exists for measuring the transmission of various chemicals through coating systems.

4.5 Adhesion

Most coating systems depend on the concrete substrate for structural integrity; therefore, maintaining good adhesion to that substrate—even after weathering and chemical exposure—is critical to coating performance. Maintaining intercoat adhesion in multilayer coating systems and patching materials is equally important. Properties of the concrete substrate that affect adhesion include surface strength, profile, cleanliness, porosity, and moisture content. Properties of the primer of the coating system that affect adhesion include viscosity, surface tension, physical strength, chemical affinity for the concrete, and resistance to alkalis and hydrolysis. For multilayer systems, properties that may affect adhesion include blush in epoxies, wax in unsaturated polyesters and vinyl esters, and numerous application-related phenomena (see Paragraphs 6.4.4 and 6.4.5). To ensure good adhesion, all the above properties are specified, inspected, and/or tested prior to and during coating application. The minimum requirement for adhesion, as tested by the methods in Paragraph 4.9.3, typically ranges from 1.4 to 2.1 MPa (200 to 300 psi). However, the mode of failure is as important as the adhesion value. Any failure mode other than cohesive failure in the concrete indicates potential adhesion problems.

4.6 Thermal Effects

4.6.1 Shrinkage from Cure and Aging

Polymers and coatings often shrink volumetrically due to cross-linking or solvent evaporation. The thermoset coatings described in Paragraph 5.2 range in potential shrinkage from less than 1% to more than 10%, depending on the type of polymer, amount of filler, amount of solvent, and extent of cure. The amount of shrinkage affects the adhesive bond between the coating and the concrete. The stress due to shrinkage can range from insignificant in low-shrink, highly elastic coatings systems, to catastrophic in high-shrink, rigid coatings. Stress due to shrinkage can intensify adhesion problems,

Provided by : www.spic.ir Licensee: NISOC Library

especially when combined with other problems such as insufficient surface preparation. This stress can either be relieved with time due to creep or thermal relaxation, or intensified with time due to continued cross-linking. When the stress and movement from shrinkage exceeds the tensile strength of the coating or adhesive strength between the coating and the concrete, the failure is usually evident as cracking in the coating and/or disbondment from the concrete. Shrinkage may be accentuated by the use of accelerators, application during high ambient or substrate temperatures, and application in thick layers. Fillers, reinforcement, and thin coats are commonly used to reduce shrinkage and distribute shrinkage stress.

4.6.2 Coefficients of Linear Thermal Expansion (CLTE)

4.6.2.1 Differences in CLTE between concrete and coatings can result in stress at that interface. As with shrinkage during curing, this stress can range from insignificant in coatings with a low CLTE, to catastrophic in coatings with a high CLTE. The ability of a coating system to maintain adhesion to the concrete substrate depends on the difference in their CLTE ($\Delta$CLTE), the bond strength, and the shear modulus of elasticity of the coating. If the $\Delta$CLTE and changes in temperature are large, the shear modulus of elasticity of the coating is high, and the creep of the coating is low, then the stress exerted on the coating/concrete interface could disbond the coating. This combination of properties is common in rigid, reinforced coating systems.

4.6.2.2 The CLTE of concrete has been reported as 8.5 to 11.7 x $10^{-6}$ mm/mm/°C (4.7 to 6.5 x $10^{-6}$ in/in/°F),[12] with an average value of 9.9 x $10^{-6}$ mm/mm/°C (5.5 x $10^{-6}$ in/in/°F) commonly used.[(7)] However, most unmodified, unfilled, thermoset resins have CLTE's higher than 45 x $10^{-6}$ mm/mm/°C (25x$10^{-6}$ in/in/°F).[90]

4.6.2.3 The addition of fillers and reinforcement can reduce the overall CLTE in polymeric coating systems to 12 x $10^{-6}$ mm/mm/°C (7x$10^{-6}$ in/in/°F) or lower to obtain a closer match to the concrete substrate; however, on a small scale, the differences in CLTE may still affect the stresses in the coating between the polymer and filler, resin and reinforcement, and different layers in the coating system. Using an elastomeric basecoat can reduce the stress exerted on a rigid coating system at a specific location by the concrete due to differences in CLTE. However, in a large area the movement due to differences in CLTE between the coating and the concrete may cause failure at a stress concentration location such as a joint or edge.

4.6.3 Thermal Shock

4.6.3.1 Resistance to thermal shock can be an important consideration when designing a secondary containment coating system. Catastrophic failure of the primary containment tank for a chemical at high or low temperatures will thermally shock the secondary containment coating. A common practice in the food industry is to clean coating systems by steam or hot water, which also produces thermal shock.

4.6.3.2 The stresses exerted on the coating and the coating/concrete interface from thermal shock are similar to the stress resulting from large differences in CLTE; however, the amount of time for the coating/concrete interface to absorb the stress is greatly reduced. Elastomeric coatings may perform better than rigid coatings in this application. Rigid systems may use mat reinforcement, an elastomeric primer, and/or a strong bond to the concrete to increase their resistance to thermal shock. Also, matching the CLTE of the coating system as closely as possible to that of the concrete substrate reduces the effects of thermal shock.

4.6.4 Installation Temperature

The installation temperature can have a profound effect on the workability, cure rate, shrinkage, physical properties, and chemical resistance of the coating. The temperature during coating application affects the rate and extent of cross-linking and the evaporation rate of solvents or low-boiling monomers. Therefore, higher installation temperatures tend to increase the shrinkage, modulus of elasticity, and chemical resistance of a coating. Problems from shrinkage stress are discussed in

[(7)] For comparison, the CLTE of carbon steel is 10.8 x $10^{-6}$ mm/mm/°C (6.0 x $10^{-6}$ in/in/°F).



Provided by : www.spic.ir Licensee: NISOC Library

Paragraph 4.6.1. While lower installation temperatures reduce shrinkage and modulus of elasticity, they also reduce strength and chemical resistance. Coatings that require elevated temperatures to adequately cure are not often used on concrete substrates for secondary containment.

4.7 Design Details

4.7.1 Joints and Cracks

Joint designs and joint and crack treatments that are used in conjunction with coating systems are discussed extensively in technical articles.[91-108]

4.7.1.1 Expected Movement

4.7.1.1.1 Many coatings are rigid and are prone to reflective cracking. Therefore, it is important to identify existing joints and cracks and quantify the maximum expected movement prior to coating selection. Monitoring joints and cracks over 24 hours helps to determine whether they are static or dynamic. Assuming there are no major structural faults, dynamic cracks can be analyzed and treated as contraction joints. Joints and cracks that have been monitored and confirmed to be static can usually be coated without special joint designs.

4.7.1.1.2 The maximum theoretical expansion and contraction at any specific contraction (control) joint can be predicted using:

(1) the shrinkage values shown in Paragraph 3.1.1.6,
(2) the CLTE values shown in Paragraph 4.6.2,
(3) the age of the concrete;
(4) the length of the concrete; and
(5) the temperature of the concrete.

Actual movement can vary due to many factors; therefore, this analysis can only be used as a guide.[12,99]

4.7.1.1.3 Isolation (expansion) joint movement is more difficult to estimate because it potentially includes movement due to shrinkage, thermal loading, and settling and may result in out-of-plane movement.

4.7.1.2 Joint Designs

4.7.1.2.1 Exposed Designs

4.7.1.2.1.1 For joints with movement greater than ±3.0 mm (0.13 in.), one successful joint design is the conventional sealed joint (see Figure 1). The width of the joint, the use of a backer rod, the width-to-thickness ratio of the sealant, and the temperature of the concrete during application of the sealant are critical to the success of this design.

4.7.1.2.1.2 In areas with aggressive chemicals, a variation on this design that includes a laminated joint sealant is sometimes used. The joint is sealed as shown in Figure 1 and then laminated or coated with a chemical-resistant sealant (see Figure 2).

4.7.1.2.1.3 Another design uses a cut joint with an attached (bonded) inflated rubber tube. The tube is rated for movement of ±50% in any direction (see Figure 3).[106]

4.7.1.2.1.4 For high-movement joints where aggressive chemical exposure is expected, a pre-formed fiberglass reinforced plastic (FRP) section can be bonded directly to the coating during application (see Figure 4).

4.7.1.2.1.5 With the exposed joint designs in Figures 1 to 3 the coating system may be extended over the sides of the joint to cover the concrete in the joint prior to application of the sealant. In this design, the sealant is bonded directly to the coating, and failure at the sealant/coating interface would not immediately expose unprotected concrete. This

Provided by : www.spic.ir Licensee: NISOC Library

design is typically used in aggressive chemical service.

4.7.1.2.2 Monolithic Designs

4.7.1.2.2.1 Depending on joint movement, coating thickness, elasticity, and adhesion, elastomeric coatings may be able to bridge low-movement contraction joints and cracks without special joint design, provided the coating remains sufficiently flexible in low temperatures.[97] Bondbreakers have been used successfully with rigid coatings at low-movement joints to prevent bonding or adhesion between the coating and the concrete (see Figure 5); they allow a wider coating section to accommodate the crack movement. Problems with this design include the stress concentration at the bonded edge of the unbonded section of the coating, which is then subject to cracking or further disbonding.

4.7.1.2.2.2 To reduce problems with the stress concentration in the bondbreaker design, reinforcement can be added to the coating to reduce the stress concentration at the edge of the bonded section and to increase the strength of the coating in the unsupported section (see Figure 6).

4.7.1.2.2.3 A design used with success in joints moving less than 2 mm (80 mils) uses an elastomeric layer to bridge the crack. The layer is directly attached to the concrete below and the monolithic coating above. This design maintains a completely bonded and monolithic coating system. (See Figure 7).[94,97,99,101,103,104] This design successfully bridges the crack only when the elastomer remains sufficiently flexible at the lowest service temperatures.

4.7.2 Terminations

Where the coating does not cover the entire concrete structure, the design of the end line or edges of the coating are important to the performance of the coating. The concrete at the edges of the coating is often cut at an angle, with coating material applied into the angled concrete (see Figure 8). This technique, called "keying in," helps the coating resist the undercutting, peeling, or disbonding stress to which the system is subjected due to installation, thermal movement, and water penetration.

4.7.3 Penetrations

For secondary containment, a monolithic coating system is typically the preferred design. However, many containment areas also support pumps, pipes, conduits, handrails, tanks, and other equipment. Attaching these items directly to the concrete substrate often causes penetrations or holes through the coating system. When possible, these penetrations are eliminated by alternative layout designs, such as using external pipe supports (see Figure 9). Remaining penetrations are sealed by various methods (see Figure 10).

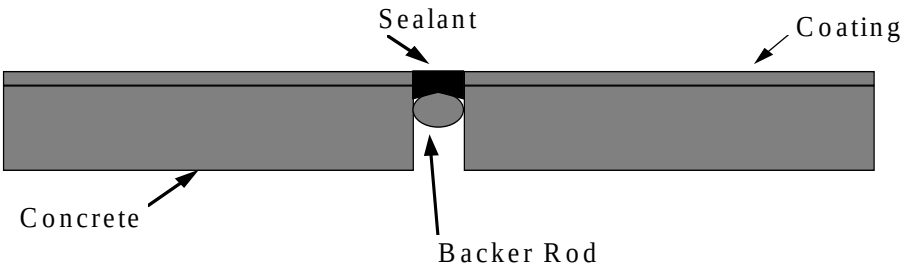



**Figure 1**
**Conventional Sealed Joint**

Provided by : www.spic.ir Licensee: NISOC Library

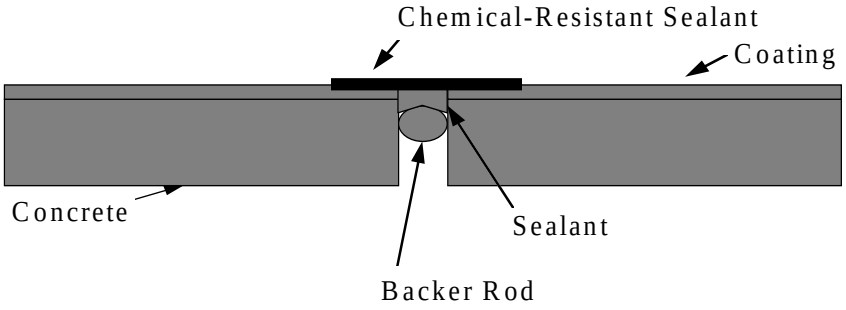



**Figure 2**
**Chemical-Resistant Sealant**

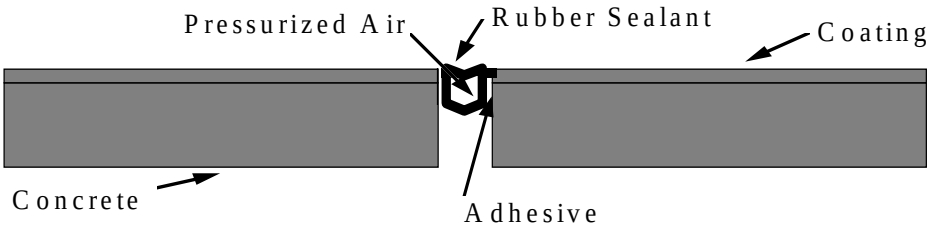



**Figure 3**
**Inflated Rubber Tube Joint Sealant**

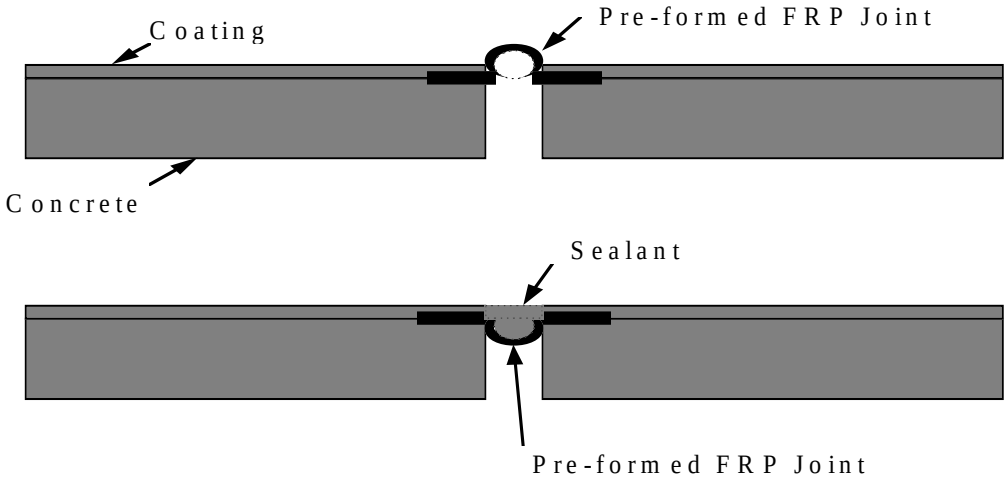



**Figure 4**
**FRP Joint Sealant**

Provided by : www.spic.ir Licensee: NISOC Library

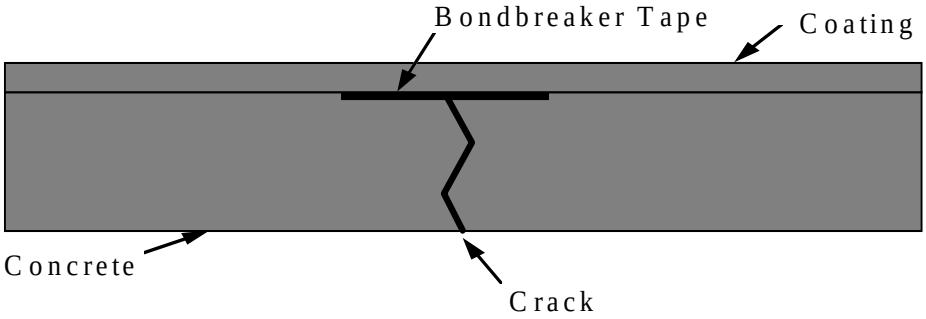



**Figure 5**
**Bondbreaker over Crack**

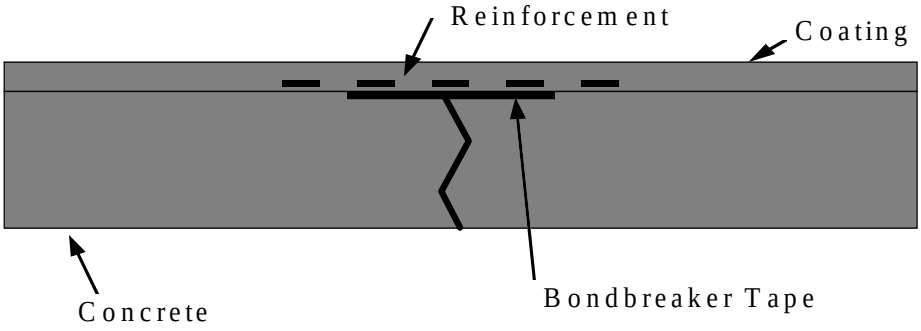



**Figure 6**
**Reinforced Bondbreaker over Crack**

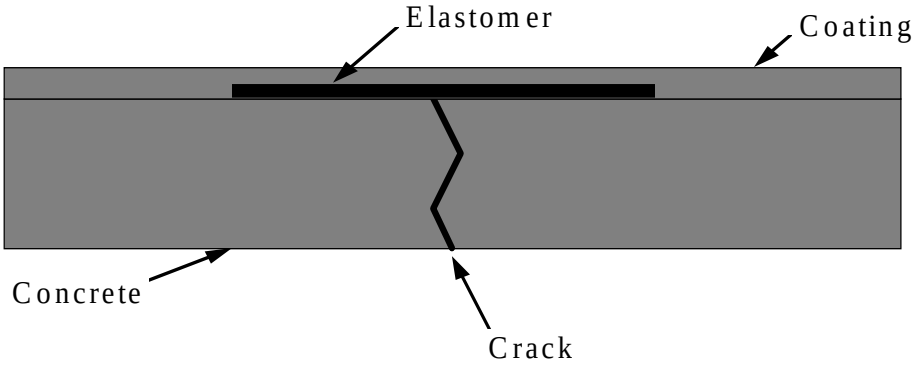



**Figure 7**
**Elastomeric Underlayer Crack-Bridging Design**

Provided by : www.spic.ir Licensee: NISOC Library

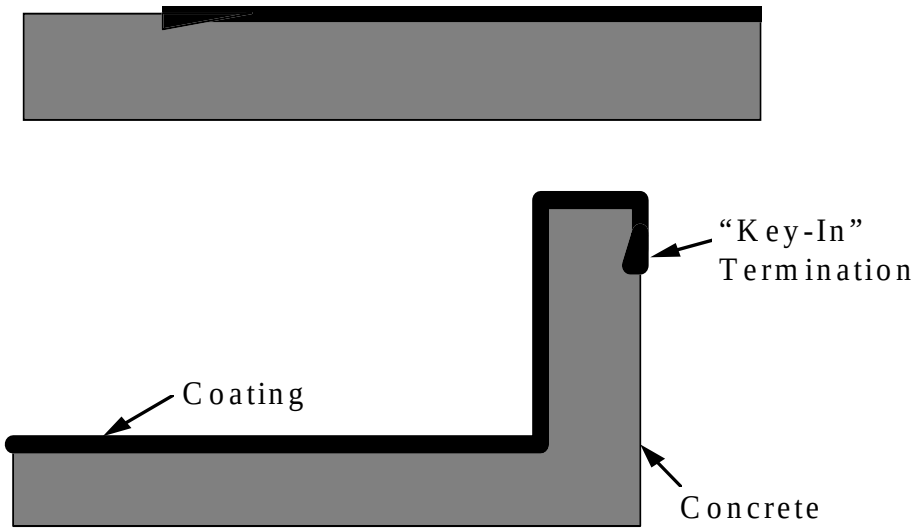



**Figure 8**
**"Key-In" Termination of Coating**

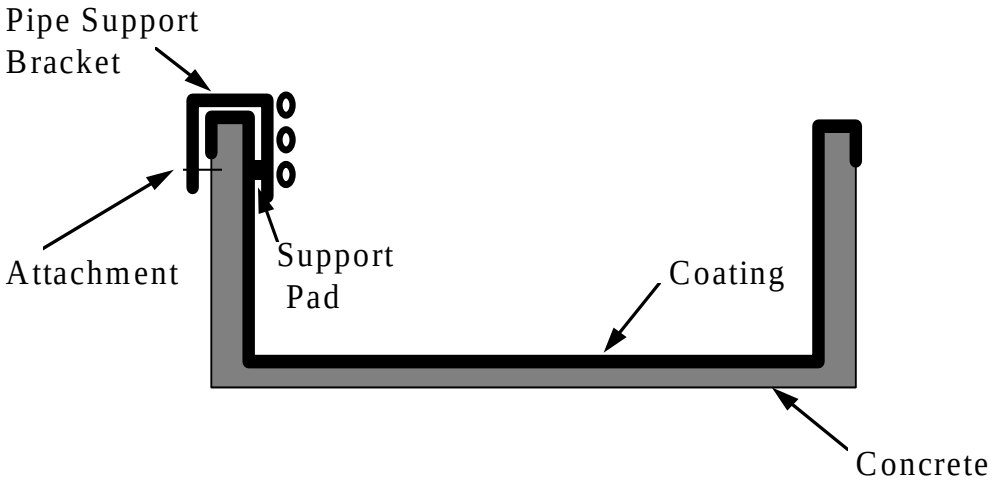



**Figure 9**
**External Penetration for Pipe Support Brackets**

Provided by : www.spic.ir Licensee: NISOC Library

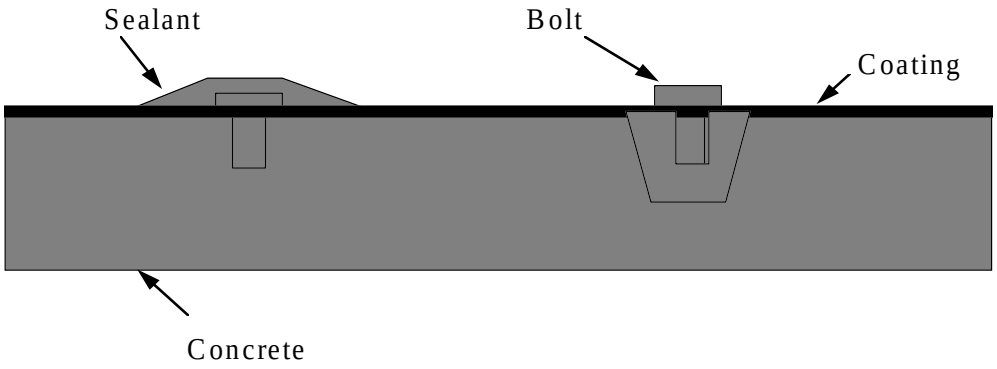



**Figure 10**
**Sealing of Penetrations Through Coating**

4.8 Other Design Factors

4.8.1 Coating Thickness

4.8.1.1 The thickness of a coating system is usually determined by the requirements for its physical properties. Tensile and flexural strength, when expressed per unit of cross-sectional area, may be identical for a specific coating at two different thicknesses, but when expressed in terms of the applied system's load-bearing capabilities, the thicker system will have a higher strength. Impact strength is also increased with thickness. For areas subjected to significant abrasion or gouging (e.g., from fork lifts), increased thickness is used to extend the life of the coating.

4.8.1.2 Thickness affects chemical resistance only if the chemical permeates the coating, as with some solvents, or if the chemical etches the coating surface significantly. Permeability is inversely proportional to coating thickness. For coatings that are not significantly affected by the chemical to be contained, the thickness of the coating is determined solely by physical requirements. The thickness of coatings on concrete ranges from 250 μm (10 mils) for liquid coatings used in mild service to 6 mm (250 mils) or higher for highly filled or reinforced systems used in heavy traffic conditions. In addition to design requirements, minimum coating thickness for thin systems is determined by the surface profile to be covered, while cost is a consideration for thick systems. Thickness is also important where shrinkage of the coating is a factor. Coatings that use polymers subject to shrinkage during cure are usually applied in thin layers or with reinforcement (see Paragraph 5.3.4) to minimize shrinkage and the resulting stress. Solvent-based coatings are also applied in thin layers to allow the solvent to evaporate.

4.8.2 Ultraviolet Light and Weathering Resistance

All thermoset polymeric materials degrade when exposed to ultraviolet (UV) light. This degradation can cause loss of gloss, color changes, chalking, or catastrophic cracking. UV degradation can be compounded by other weathering factors such as rainwater, condensation, humidity, and thermal cycling. UV degradation in coatings can be reduced by the use of inorganic pigments and fillers, UV absorbers, and free-radical scavengers, as well as by the use of UV-resistant topcoats.

4.8.3 Skid Resistance

Where foot traffic is expected and where the floor of the containment area may be wet from spills, cleaning, or rainwater, skid resistance is an important safety factor. Skid resistance is accomplished by:

(1) not topcoating over the residual texture of a trowelled or broadcast system,
(2) brushing or rolling a texture (stipple) into a thixotropic topcoat, or
(3) adding aggregate particles when applying a liquid-rich sealing topcoat.

4.8.4 Aesthetics

Provided by : www.spic.ir Licensee: NISOC Library

While appearance is not a functional requirement for secondary containment coatings, these systems are sometimes applied in locations that are highly visible and may need to be aesthetically pleasing. This factor is often not addressed in specifications or contracts. There are many reasons that coating systems may not look perfectly uniform. Mat-reinforced systems may have mat overlap lines or mat surface profile. Trowel-applied coatings may have trowel marks. Skid-resistant surfaces may have nonuniform texture. In addition, deteriorated concrete may not have been restored and substrate imperfections may remain.

4.9 System Compatibility Testing

The following is a list of test methods that can be used to quantify the physical properties of a specific coating system and verify its compatibility with a specific environment.

4.9.1 Chemical Immersion Testing

4.9.1.1 Cell Testing

Cell testing is an immersion test for a coating system applied to a substrate and exposed to a chemical. The following test methods can be modified to use concrete as the substrate.

(1) ASTM C 868[109]
(2) NACE TM0174[110]
(3) ASTM D 4398[111]

4.9.1.2 Immersion Testing

Immersion testing is performed with a molded or free-film sample of the coating (no substrate) that is immersed in the chemical (or water) and monitored for changes in properties and appearance.

(1) ASTM C 267[112] Chemical resistance test
(2) ASTM C 413[113] Water absorption test
(3) ASTM D 543[114] Chemical resistance test

4.9.2 Physical Testing

4.9.2.1 Tensile Strength

(1) ASTM C 307[115]
(2) ASTM D 412[116]
(3) ASTM D 638[117]

4.9.2.2 Modulus of Elasticity and Elongation

(1) ASTM D 412
(2) ASTM D 638
(3) ASTM C 580[118]

4.9.2.3 Flexural Strength

(1) ASTM C 580

4.9.2.4 Compressive Strength

(1) ASTM C 579[119]

4.9.2.5 Fracture Toughness

(1) ASTM D 5045[120]

4.9.2.6 Impact Resistance

(1) ASTM D 2794[121]

4.9.2.7 Permeability

(1) ASTM E 96[122] is used to determine the water vapor transmission (WVT) of materials. This test can be conducted at a variety of temperatures and vapor pressure differences. The WVT rate is the water vapor flow in unit time through a unit area. The water vapor permeance (WVT/vapor pressure difference) is a performance evaluation at a stated thickness and is not a property of the material. The water vapor permeability (permeance x thickness) is a property of the material.

4.9.3 Adhesion Testing[32] (see Paragraph 3.2.1.2)

Testing for adhesion after various exposure tests may be a better indicator of expected performance. For example, adhesion testing can be performed after immersion testing, after UV exposure, after impact testing, and after thermal cycling.

(1) ASTM D 4541
(2) ACI 503R, Appendix A

4.9.4 Thermal Testing

The effect of temperature and heat on coatings may be quantified by using the standardized tests listed below.

Provided by : www.spic.ir Licensee: NISOC Library

4.9.4.1 Shrinkage

(1) ASTM C 531[123]
(2) ASTM C 883[124]

4.9.4.2 Thermal Expansion

(1) ASTM C 531
(2) ASTM C 884[125]

4.9.4.3 Maximum Temperature

(1) ASTM E 1356[126]

4.9.5 Crack-Bridging Testing

At the time of publication, except for the DIBt testing performed in Germany, no standardized test methods had been published or proposed for determining the crack bridging performance of coating systems in secondary containment applications. Crack-bridging tests have been performed by various methods and have been used as a research tool to compare the performance of different coating systems.

(1) DIBt[(8)] Crack and Containment Test[92]
(2) Sandwich Tensile Test[94,95,97,99,102,104]

4.9.6 UV Testing

(1) ASTM D 4587[127]

4.9.7 Acceptance Criteria

Materials qualified for a specific application are usually based on testing of new lab-applied materials; performance may vary for materials applied in field conditions and that have weathered.

## Section 5: Coating Systems

5.1 Most coating system formulations and designs are proprietary. The properties and performance within a generic classification will vary. The coating manufacturer is the best source of information on the applications, installation, performance, designs, and verifiable field histories of its specific materials and systems. This section provides an overview of typical generic coatings used in secondary containment.[34,47,59-80,128-164]

5.2 Polymer Types

Table 3 lists typical physical and chemical resistance[165-168] properties for the most common materials used in secondary containment as protective barrier coating systems. This table is not intended as a guideline for selecting specific polymer types. Actual properties for coating systems can vary widely from the typical properties shown here due to polymer modifications, mixtures (hybrids), plasticizing, fillers, reinforcement, and curing conditions. The ranges shown for the properties of each generic coating material reflect differences in the particular types of resins used and differences in specific formulations. Section 4 explains the importance of specific coating properties and discusses some methods used to overcome the deficiencies of a given polymer.

5.2.1 Epoxies[34,60,147,161]

Thermoset epoxies are co-reactive polymers that are reaction products of epoxy resins and amine hardeners. Common epoxy resins include bisphenol A, bisphenol F, and phenol novolac-based epoxy resins. Commonly used hardeners include aliphatic amines, cycloaliphatic amines, amidoamines, and polyamides. Numerous modifiers, diluents, and solvents are included in most formulations. With modifications, epoxy coatings can range from hard and brittle with good chemical resistance to flexible with reduced chemical resistance. Novolac-based epoxy resins reacted with aliphatic or cycloaliphatic amines produce coatings with high cross-link densities and good chemical resistance; they are often used to contain aggressive chemicals. In the past, aromatic amines were commonly used in highly chemical-resistant formulations, but toxicity concerns and regulations have significantly reduced their current use. The most commonly used epoxy coatings exhibit high strength, adhesion, and chemical resistance, but low flexibility and UV resistance.

5.2.2 Unsaturated Polyesters (UP)[60]

Unsaturated polyesters are co-reactive polymers that are reaction products of UP resins and peroxide initiators. The reaction products of saturated and unsaturated acids and polyols are common UP resins. The resins are diluted with a vinyl co-reactant, usually styrene. Methyl ethyl ketone peroxide, cumene hydroperoxide, and benzoyl peroxide are common initiators for UP resins, while cobalt or tertiary

[(8)] Deutsches Institut fur Bautechnik (DIBt), Reichpietschufer 74-76, 10785, Berlin, Germany.

Provided by : www.spic.ir Licensee: NISOC Library

amines are used to promote the reaction. The common unsaturated polyester coatings exhibit high strength and good chemical resistance, but they are prone to shrinkage and air inhibition during curing.

**TABLE 3**
**Typical Properties of Common Generic Coating Materials Used in Secondary Containment**

| Polymer | Epoxy | Polyester | Vinyl Ester | Polyurethane/ Polyurea | Polysulfide | Acrylic | Furan | Epoxy Siloxane |
|---|---|---|---|---|---|---|---|---|
| Physical Strength | High | High | High | Low to Medium | Low to Medium | Medium to High | High | High |
| Elongation | Low | Low | Low | Medium to High | Medium to High | Low to Medium | Low | Low |
| Impact Resistance | Medium | Medium | Medium | Medium to High | Medium to High | Medium to High | Medium | Medium |
| Abrasion Resistance | Medium to High | Medium to High | Medium to High | Medium to High | Medium | Medium to High | High | Medium to High |
| Adhesion to Concrete | High | Medium | Medium | Medium | Medium | Medium | Medium | High |
| Cure Shrinkage | Low | High | High | Low | Low | High | High | Low to Medium |
| Permeability | Low | Low | Low | Medium | Medium | Low to Medium | Low | Low |
| UV Resistance | Low | Medium to High | Medium | Low to High | High | High | Medium | Low to Medium |
| Creep | Low to Medium | Low to Medium | Low to Medium | High | High | Low to Medium | Low | Low to Medium |
| Temperature Limit | Medium to High | Medium to High | Medium to High | Medium | Medium | Medium | High | Medium |
| **Chemical Resistance** | | | | | | | | |
| Inorganic Acids | Medium to High | Medium to High | Medium to High | Low to Medium | Low to Medium | Medium | High | Medium to High |
| Organic Acids | Medium | High | High | Low to Medium | Low to Medium | Medium | Medium to High | Medium to High |
| Alkalis | High | Medium | High | Low to Medium | Low to Medium | High | Medium to High | High |
| Chlorinated Solvents | Low to High | Low to High | Medium to High | Low to Medium | Low to Medium | Low to Medium | High | Medium to High |
| Oxygenated Solvents | Low to High | Low to High | Medium to High | Low to Medium | Low to Medium | Low to Medium | Medium to High | Medium to High |
| Hydrocarbon Solvents | Medium to High | Medium to High | Medium to High | Low to Medium | Low to Medium | Low to High | High | Medium to High |
| Salts | High | High | High | Medium to High | Medium to High | High | High | High |
| Water | Medium to High | Medium to High | Medium to High | Medium to High | Medium to High | Medium to High | Medium to High | Medium to High |

Provided by : www.spic.ir Licensee: NISOC Library

5.2.3 Vinyl Esters (VE)[143,147]

Vinyl esters are co-reactive polymers that are reaction products of VE resins and peroxide initiators. The reaction products of methacrylic acid and epoxy resin (bisphenol A, F, or novolac) are common VE resins. These resins are typically diluted with a vinyl co-reactant, usually styrene; they may also be modified with an elastomer. Methyl ethyl ketone peroxide, cumene hydroperoxide, and benzoyl peroxide are common initiators for VE resins, while cobalt or tertiary amines are used to promote the reaction. The common vinyl ester coatings exhibit high strength and good chemical resistance, but they are prone to shrinkage and air inhibition during curing.

5.2.4 Polyurethane/Polyurea[77,151-153,158]

Thermoset polyurethanes are co-reactive polymers that are the reaction products of polyol resins and isocyanates. Thermoset polyureas are co-reactive polymers that are reaction products of amines and isocyanates. Often, mixtures of polyols and amines are reacted with isocyanates to produce polyurethane/ polyurea hybrids. Many classes and types of polyols, amines, and isocyanates are commonly used in coatings.[130] Polyurethanes and polyureas can be subclassified as elastomeric (>100% elongation) or nonelastomeric (<100% elongation); they are also classified as either aromatic or aliphatic, depending on the type of isocyanate used. Polyurethane coatings can range from high strength with good chemical resistance to very flexible with reduced strength and chemical resistance. Aliphatic polyurethanes have better UV resistance than aromatic polyurethanes.

5.2.5 Polysulfide[133]

Polysulfide is a synthetic elastomer formed by the oxidation and condensation reaction of thiol functional polysulfide resins initiated by metal oxides or peroxides. Polysulfide coatings have high flexibility and UV resistance but low strength. Polysulfide hybrid polymers are formed by co-reacting with epoxy or epoxy and amine resins. The hybrids usually have higher strength and improved adhesion.

5.2.6 Acrylic[154]

Acrylics used in secondary containment usually consist of a mixture of high-molecular-weight acrylic resins that are co-reacted with methyl methacrylate in a free-radical polymerization initiated by peroxide. Acrylics can vary in strength and flexibility depending on the choice of raw materials; however, like unsaturated polyester and vinyl ester coatings, these materials are prone to shrinkage and air inhibition during curing.

5.2.7 Furan

Furan resins are usually condensation products of furfural and/or furfuryl alcohol. These resins are cross-linked using an acid catalyst, such as a sulfonic acid, to form a dark, infusible, solid coating. Furan coatings are usually hard and brittle with high heat resistance and good chemical resistance, but they are prone to shrinkage and do not adhere well to concrete.

5.2.8 Epoxy Siloxane[162,163]

Epoxy siloxanes are hybrid resins produced using new technology. One formulation method is to pre-react epoxy resin with silica to form a hybrid resin that is then homopolymerized or cross-linked with an amine to form a coating.[162] Another method is to cross-link an epoxy resin with an amine and aminosilane to form a hybrid coating.[163] Epoxy siloxane coatings have physical properties similar to amine-cured epoxy coatings and have high chemical resistance.

5.2.9 Other Thermoset Polymers

Other thermoset polymers used as secondary containment coatings include chemically cross-linked elastomers[164] and hybrids such as epoxy phenolic, polyurethane-modified epoxy, and acrylic urethane.

5.3 Reinforcement and Fillers

5.3.1 Silica Fillers

Silica fillers (including silica sand, glass, quartz, and various silica-containing minerals) are the most commonly used fillers for secondary containment coatings. They are used at levels up to 80% by weight. They can range in size from less than 1.0 μm (0.04 mils) to one-fourth the coating thickness and may be round particles or flakes. The advantages of using silica fillers include reduced coating cost, permeability, cure shrinkage, and CLTE, and increased chemical and creep resistance. The disadvantages include reduced flexibility and tensile strength.

5.3.2 Carbon Fillers

Provided by : www.spic.ir Licensee: NISOC Library

Carbon and graphite fillers cost more than silica and other minerals and are generally used only when their specific properties are required. Like silica fillers, they can be used at high levels, can range in size from a micrometer (0.04 mils) to one-fourth the coating thickness and may be round particles or flakes. Carbon and graphite fillers are conductive and can be used for conductive primers and conductive floors. They are resistant to all chemicals, including HF and concentrated alkalis. In addition, they are nonsparking, and so are used in explosion-proof areas. In addition to these special properties, carbon fillers reduce permeability, cure shrinkage, and CLTE, and increase chemical and creep resistance. The disadvantages include reduced flexibility, strength, and hardness; also, the only color available is black.

5.3.3 Other Functional Fillers

5.3.3.1 Pigments—primarily titanium dioxide and other inorganic oxides—are used mainly for aesthetic purposes and to protect the polymer from UV degradation. Pigments also reduce permeability.

5.3.3.2 Flake-shaped materials are a special class of filler that are used primarily to reduce permeability; they are especially effective when they are included in the coating at the correct level and aligned parallel to the coating surface. Commonly used flake-shaped fillers include glass, mica, and graphite.

5.3.3.3 Many fillers, including silicas, are treated with functional organosilanes. Incorporating these treated fillers into the coating can increase physical strength, increase chemical resistance, and reduce porosity.

5.3.4 Fiberglass Mat Reinforcement[60,136,157]

Fiberglass mats are sometimes used as structural reinforcement in coating systems. They are particularly useful in applications where maintaining a monolithic structure is required. Chopped strand and woven fiberglass mats are commonly used. UP, VE and epoxy coating systems often use fiberglass reinforcement. Fiberglass-reinforced coating application techniques are similar to those used in other industries and include hand lay-up, chopper gun, and spray application with or without a chopper gun attachment. Reinforcement levels up to 50% by weight are possible. Fiberglass mat reinforcement in coating systems increases tensile strength, flexural strength, compressive strength, impact resistance and crack-bridging performance. In addition, it distributes the stress during shrinkage in UP and VE resins. For some coating systems, use of a mat reinforcement increases the structural integrity of the system to the point where the weak point in the coating system becomes the coating/concrete interface, which increases the possibility of disbonding.

5.3.5 Surface Veils

Surface veils are thin, low-weight fiberglass or polyester mats that are used to reinforce the surface of a coating system. They are used to reinforce the surface of thick resin layers in aggressive chemical exposures and to reduce cracking in thermal shock conditions.

5.3.6 Other Mat Reinforcement[144]

Polyester and carbon mats can also be used as reinforcement. These mats are more expensive than glass mats and are used only in special applications where their specific properties are required.

5.4 Other Formulation Components

Although formulation of thermoset polymer coating materials is beyond the scope of this report and is usually proprietary, coatings typically contain numerous components in addition to the polymer, filler, and reinforcement. These components are used to enhance the storage, application, or performance of the coating and may include solvents, diluents, accelerators, inhibitors, anti-microbials, thixotropes, UV screens, coupling agents, defoamers, and surface tension additives.

5.5 Alternative Systems

Systems other than thermoset coating systems used in secondary containment include acid-resistant brick and membrane systems, double-walled pipes or tanks, pre-formed thermoplastic inlays or liners,[134,135] sulfur concrete, lacquers, latexes, and polymer concrete.

Provided by : www.spic.ir Licensee: NISOC Library

## Section 6: Coating System Installation[170-174]

6.1 Concrete Cure and Surface Preparation

6.1.1 Coating application proceeds when the concrete has adequate surface strength, surface profile, surface porosity, surface dryness, and surface cleanliness. Surface preparation is covered in Paragraph 3.3.

6.1.2 Concrete has traditionally been coated no sooner than 28 days after concrete placement. This 28-day waiting period is a controversial topic that involves all facility owners, coating manufacturers, applicators, and specifiers. The 28-day waiting period originated as a civil engineering structural requirement and was adopted by the coating industry because it usually allows sufficient time for the required concrete surface strength to develop and for excess moisture to evaporate.[27] Many factors affect strength and moisture movement in concrete that can reduce or increase the time required for strength and moisture levels to be acceptable. In addition, many construction schedules do not allow for a 28-day waiting period. For these reasons, quantified surface requirements, as in Paragraph 3.3.3, are often specified rather than a period of time. For enclosed areas, dehumidification equipment has been used to reduce the drying time of concrete (after sufficient strength has been achieved) and to reduce humidity during installation, preventing premature failure of the coating.[36,175]

6.1.3 NACE RP0892[63] and ACI 515.1R[47] do not refer to a specific cure period, but they address surface dryness, surface strength requirements, and other surface quality issues. NACE RP0591[62] states that concrete normally requires a 28-day cure. NACE RP0376[61] recommends a 30-day cure for most new concrete floors. The cure time drops to 14 days if the floor is moist cured for seven days and allowed to dry for seven days. If ASTM C 150 Type III cement is used, the concrete can be moist cured for three days and allowed to dry for two days.

6.2 Patching of Concrete Surface Imperfections

6.2.1 Types of Imperfections

Concrete defects such as voids, bugholes, and excess porosity and physical and chemical damage are usually filled or repaired prior to application of the coating system (see Paragraphs 3.2.2 and 3.2.3). Some systems, such as thick, trowelled systems, may tolerate minor imperfections without repairs, and some systems, such as spray-applied coatings, may be applied immediately after patching. However, most coatings cannot be successfully applied until defects and damage are repaired and adequately cured.

6.2.2 Patching Materials

6.2.2.1 Materials such as grouts, putties, fillers, and sealers are used to repair, patch, smooth, or seal the concrete surface to provide a substrate that is suitable for the coating system to be applied. These materials are applied after initial surface preparation and, when properly selected and applied, have the following characteristics:

(1) good adhesion;
(2) adequate strength:
(3) low volumetric shrinkage;
(4) compatibility with the coating to be applied; and
(5) proper consistency for the application.

6.2.2.2 In addition, the patching material is often expected to cure sufficiently, be traffic bearing, and be ready to recoat in a short time frame (usually within 24 hours). The repaired section is evaluated to determine whether to perform additional surface preparation prior to coating application.

6.2.2.3 Shrinkage of the patching material may reduce the adhesion of that material to the concrete substrate. Differences in thermal expansion between the concrete, patching material, and coating system will cause stresses during thermally induced movement that may reduce adhesion between these layers.

6.2.2.4 The most common types of patching materials are cementitious, polymer-modified cementitious (usually acrylic), and polymeric (usually epoxy).[176] Cementitious materials cost less than polymeric materials, but polymeric materials generally cure faster and have higher strength, better adhesion, and increased chemical resistance.

6.2.2.5 Patching materials are available in a range of consistencies for application to vertical or horizontal surfaces by a variety of methods. The

Provided by : www.spic.ir Licensee: NISOC Library

amount of filler also varies. For example, grouts for deep patching are typically highly filled, while porosity sealers may be minimally filled or unfilled.

6.3 Priming

6.3.1 Materials

6.3.1.1 Although the primer is generally considered part of the coating system and is often formulated with a polymer similar to that used in the coating, certain properties and performance criteria are critical for this component. Adhesion to concrete is most important. Low surface tension and low viscosity in a primer help to wet and penetrate the porous concrete surface. Resistance to alkali and hydrolysis are also important properties for a primer applied directly to concrete because concrete is an alkaline material and moisture is often present.

6.3.1.2 The use of solvent- or water-based materials as primers on concrete substrates is common; however, the stresses introduced from the shrinkage of these primers and the time required for sufficient evaporation of the solvent or water prior to applying the next coat are important factors to consider.

6.3.1.3 Some primers function as porosity sealers that either fill or bridge pores in the concrete surface and prevent holidays and pinholes in subsequent coats.

6.3.1.4 Specially formulated primers have been designed for application to freshly placed concrete and function to seal the concrete, provide a primer for the coating, and eliminate the need for surface preparation.[177] These materials are designed only for specific applications, as recommended by the manufacturer, and may not always perform as well as primers applied to concrete surfaces that have been cured, dried, and prepared.

6.3.2 Application

Primers are applied to concrete surfaces using the same techniques by which the coating materials are applied. Additional techniques may be used with primers to reduce the occurrence of holidays due to outgassing (see Paragraph 6.3.4).

6.3.3 Conductive Primers

Conductivity in concrete can range significantly depending on concrete type, density, moisture content, and rebar location. If the conductivity of the concrete structure to be coated is low and discontinuity testing is specified for the coating to verify a holiday-free application, a conductive primer can be used to ensure effective discontinuity testing.

6.3.4 Outgassing

Porosity in the concrete contains air. When the temperature of the concrete rises, the air in the pores expands. This phenomenon, commonly called outgassing, may produce pinholes or blisters in primers and coating systems. To reduce the risk of pinholes as a result of outgassing, the primer and coating are usually applied when the concrete temperature is stable or dropping.

6.4 Coating System

6.4.1 Materials

Coating materials perform best when they are stored, mixed, and diluted according to the manufacturer's recommendations.

6.4.1.1 Storage

Storage under adverse conditions or beyond the shelf life of the coating may affect the condition of the materials and the properties of the coating. Manufacturers typically recommend that most coating materials be stored at 10 to 30°C (50 to 86°F); however, it is not uncommon for materials to be subjected to temperatures as low as -10°C (14°F) or as high as 50°C (122°F) during shipping. These adverse conditions may cause materials to crystallize or polymerize.

6.4.1.2 Diluting

Diluting coating materials with solvents or water, unless specifically recommended by the manufacturer, can cause problems such as incompatibility, solvent retention, and film defects in the cured product.

6.4.1.3 Mix Ratios

Materials are usually packaged by the manufacturer in precise mix ratios to ensure optimal cured properties of the applied coating. Deviating from the prescribed mix ratio can affect the physical properties and chemical resistance of

Provided by : www.spic.ir Licensee: NISOC Library

the coating. Accelerators and initiators in unsaturated polyester and vinyl ester systems are sometimes added in the field to adjust for environmental conditions or accelerate the cure of the coating. While this practice may be invaluable for some coatings, these components usually affect the properties of the cured coating. Excessive hardener and some accelerators may reduce the gel time (i.e., the time until the coating sets) of epoxy coatings, but they may not increase the cure rate and usually have a detrimental effect on the coating's properties.

6.4.2 Application Methods

The main objectives when applying coating materials are to ensure (1) that all components are properly mixed, (2) that the coating or coating layer is applied at the designed thickness range, (3) that the resulting application is free of defects that may affect performance, and (4) that the applied coating cures sufficiently before being placed in service. The following paragraphs provide a brief description of the application methods. For more information, the coating manufacturer can be consulted or see references 65 and 178.

6.4.2.1 Mixing

The most common method for mixing two-component materials utilizes a mixing blade attached to a power drill or motor. Manual mixing may not be adequate to homogenize the coating materials. Each component of a two-component coating may separate or settle during storage and shipping and may need to be individually mixed before mixing with the other component. Three-component or highly filled two-component materials are often mixed with a motorized bucket mixer.

6.4.2.2 Spraying

One- and two-component materials that do not contain large fillers are often applied using spray equipment. Air-assisted or high-volume, low-pressure (HVLP) spray equipment can be used for one-component or premixed two-component materials. Plural-component, high-pressure airless spray equipment with heated lines and air-assisted spray guns are commonly used with two-component, high-solids materials.

6.4.2.3 Other Methods

Trowelling (manual or power) and broadcasting are common methods for applying aggregate-filled systems. Broadcasting and power trowelling are only used on horizontal surfaces. High-build liquid-rich systems are also applied to horizontal surfaces by self-leveling methods such as mixing, pouring, using a squeegee, or rolling (usually with a spiked roller). Many coatings are applied by rollers and brushes.

6.4.3 Reinforcement[169]

Methods for installing reinforced systems or inserting reinforcement into coating systems include the use of conventional hand lay-up techniques and chopper gun attachments for one- or two-component spray equipment. Whichever method is used, it is important to mechanically work the saturating resin into the reinforcement and eliminate any entrapped air (especially at corners, edges, and overlaps), usually using a ribbed, or serrated, roller.

6.4.4 Recoat Windows

Proper adhesion between all layers of a multilayer coating system is essential for coating performance. To attain that adhesion, each layer is mechanically and/or chemically bonded to the previous layer. The time between application of two layers in a multilayer coating system is the recoat time. The optimum range of times within which to apply the second layer is commonly called the recoat window and is usually specified by the coating manufacturer. Specifying a minimum time allows an applied layer to cure sufficiently to support traffic from the applicator and ensures that the applied layer is not harmed by solvents in the next layer. This minimum is known as the dry-to-recoat time. The maximum ensures that the applied layer is not completely cured, so that subsequent layers can react and bond sufficiently with the applied layer. If the maximum recoat window is exceeded, it may be possible to prepare the existing surface by abrasive or mechanical methods to accept a subsequent coating. Environmental factors such as temperature, humidity, and direct sunlight may affect the cure and, hence, the recoat window.

6.4.5 Environmental Conditions

6.4.5.1 Temperature

Provided by : www.spic.ir Licensee: NISOC Library

The temperatures of the coating materials, the concrete substrate, and the surrounding air affect the workability, cure rate, and resulting properties of the coating. Unless they are specially formulated, many thermoset coatings are designed to be applied at a relatively narrow range of temperatures, such as 10° to 32°C (50° to 90°F). Lower temperatures tend to increase viscosity, reduce evaporation rate of solvents or volatile co-reactants, and reduce the cure rate. Higher temperatures tend to reduce viscosity, increase evaporation rate, and increase cure rate. Materials applied at higher temperatures may result in coatings with increased residual stress from shrinkage. Direct sunlight can increase the effective surface temperature by up to 30°C (50°F) over the shaded temperature; in addition to the effects from elevated temperature, direct sunlight can cause the top surface to cure before the rest of the coating, a phenomenon known as skinning. Applying a coating to concrete when the concrete temperature is rising can cause outgassing (see Paragraph 6.3.4).

6.4.5.2 Moisture

Excessive moisture can profoundly affect the cure of many thermoset materials commonly used in secondary containment. Moisture may be present due to residual water in the concrete, water condensed on the concrete, high humidity, rain, or a high water table. The effects of excess moisture include blushing of amine-cured epoxies, cure inhibition of unsaturated polyesters and vinyl esters, poor film formation in water-based coatings, and $CO_2$ formation in polyurethanes. In addition to testing for residual moisture (see Paragraph 3.2.5.1), coatings that are affected by excess moisture are usually applied when the concrete surface temperature is at least 3°C (5°F) above the dew point and the relative humidity is below 80%.

6.4.5.3 Air Movement

Although some air movement may be required for worker safety when applying coatings containing volatile materials, excessive air movement can affect coating properties by causing excessive evaporation rates. Stagnant air in contained areas may inhibit the cure on the surface of styrene or methyl methacrylate systems that use a wax-containing sealer coat.

6.4.6 Cure

For thermoset coating materials, the cure is usually a complex function of time and temperature. In most cases, the coating is formulated to cure as rapidly as possible while still providing sufficient pot life. The extent of cure directly affects the physical strength and the chemical resistance of a coating, both of which increase as the cure progresses. With multilayer coating systems, the applied layer is usually formulated to cure as soon as possible so it can support traffic from the applicator and so it is not harmed by solvents or stresses from application of the subsequent layers. Most coating systems used in secondary containment are designed to cure at ambient conditions (usually 10°C to 30°C [50°F to 86°F]); they typically gel when 40 to 70% cured, are able to support traffic (dry to handle) when 50 to 80% cured, and are 70 to 100% cured after seven days. Some coating systems are formulated to cure outside the usual temperature range. In some cases, curing at elevated temperature is essential to impart sufficient chemical resistance to coatings. Some materials, even if they are designed to cure at ambient temperatures, may benefit from curing at elevated temperature. Elevated temperatures increase the glass-transition temperature ($T_g$), cross-link density, and rate and extent of cure. These factors usually increase the chemical and heat resistance but may also reduce elasticity and increase brittleness of the resultant coating.

6.5 Testing and Inspection[174,179-181]

The following test methods can be used to quantify the properties of the installed coating system.

6.5.1 Concrete Substrate (see Paragraph 3.3.3)

6.5.2 Coating Thickness

(1) ASTM D 4414[182] is a wet film thickness test that is performed during coating installation.
(2) ASTM D 4138[183] is a destructive method that is not accurate on concrete unless numerous specimens are tested.
(3) Ultrasonic thickness tests use new technology to take nondestructive thickness measurements of cured coatings on concrete.[184]

Provided by : www.spic.ir Licensee: NISOC Library

6.5.3 Discontinuity Testing[185]

(1) ASTM D 4787[186]
(2) NACE RP0188[187]

6.5.4 Cure Evaluation

(1) ASTM D 2583[188] Hardness Test
(2) ASTM D 5402[189] Solvent Rub Test
(3) ASTM E1356[126] Glass Transition Temperature ($T_g$)

6.5.5 Adhesion Testing[26,32] (see Paragraph 3.2.1.2)

(1) ASTM D 4541
(2) ACI 503R, Appendix A
(3) Patch Test (see Paragraph 3.2.1.2.3)

## Section 7: Maintenance

7.1 Spill Cleanup

Numerous regulations exist for the collection, cleanup, and disposal of hazardous materials. Many secondary containment and process areas include drains where the spilled materials are collected for recycling, treatment, or disposal. In cases where the chemical to be contained may damage the coating (e.g., from etching or swelling), and because polymeric materials are permeable to some chemicals, it is beneficial to dilute or remove the chemical as soon as possible.

7.2 Inspections

Routine inspections on secondary containment installations can prolong their service life. Early detection and correction can minimize damage to the coating. In addition, early detection often allows coatings to be repaired prior to undercutting and substrate damage. The details that are noted during inspection include:

(1) chemical degradation (color change, etching, flaking, softening, or swelling);
(2) physical damage (impact cracking, indentation, gouging, or tearing);
(3) disbondment (blistering, undercutting, or shearing);
(4) cracking at joints, edges, or corners; and
(5) weathering (chalking or crazing).

Disbondment may not be visually evident. The coating surface may be tapped with a metal object (known as sounding) to check for disbonding. Cracking may not be visually evident when the coating is expanded due to elevated temperatures but can be checked by applying water or a dye, or by waiting until the coating temperature is lower.

7.3 Repairs[190,191]

7.3.1 Secondary containment coatings that are disbonded, cracked, physically damaged, or chemically attacked are repaired to restore the expected performance of the systems. Prior to repairing the coating, it is useful to diagnose the reasons for the coating failure and either repair the cause of the failure along with the coating, or redesign the coating system to accommodate the conditions. As discussed in Section 4, cracks in the coating may be caused by: concrete movement as a result of shrinkage, thermal effects, design, or foundation deficiencies; high $\Delta$CLTE; coating shrinkage; or UV degradation. Disbondment may be due to: contamination or insufficient surface preparation; severe thermal shock or cycling; excessive coating shrinkage; poor coating penetration of concrete surface or poor adhesion; or hydraulic pressure problems. Physical damage is often caused by fork lifts and heavy vehicular traffic; chemical degradation results from incompatibility of the coating with chemical spills.

7.3.2 The criteria for a successful repair are similar to those used in the initial installation: all disbonded or damaged coatings and concrete are removed until only sound concrete (or sound, bonded coating) remains; all contamination is removed; the repair coating bonds to the existing coating; the existing concrete and/or coating is properly prepared; and all cracks are addressed in the repair coating system design. Many thermoset coatings adhere to existing thermoset coatings, provided the surface of the existing coating is prepared to give a sufficient surface profile. The repair coating is tested for adhesion by any of the methods discussed in Paragraph 3.2.1.2.

## Section 8: Safety

8.1 Numerous health, safety, and environmental regulations address worker safety, a topic beyond the scope of this report. Potentially hazardous materials encountered during the handling and application of secondary containment coatings include: the chemicals to be contained; cleaning solutions, abrasive media, and by-products of surface cleaning and preparation; and liquid resins, catalysts, and solvents

Provided by : www.spic.ir Licensee: NISOC Library

in coating materials. Material safety data sheets are a source of information on the hazards and handling of hazardous materials. NACE TPC Publication 2[64] and the SSPC Painting Manual[178] provide information on safety during coating application.

## Section 9: Glossary of Terms

**Accelerator**: A substance which, when added to concrete, mortar, or grout, increases the rate of hydration of the hydraulic cement, shortens the time of setting, or increases the rate of hardening, strength development, or both.[192]

**Accelerator**: Any substance used in small proportion which increases the speed of a chemical reaction. In the paint industry, the term usually indicates materials that hasten the curing or cross-linking of a resin system. In the polyester resin field, it covers more specifically an additive which accelerates the action of the catalyst.[193]

**Adhesion**: State in which two surfaces are held together by interfacial forces which may consist of valence forces or interlocking action, or both.[193]

**Aggregate**: Granular material, such as sand, gravel, crushed stone, crushed hydraulic-cement concrete, or iron blast-furnace slag, used with a hydraulic cementing medium to produce either concrete or mortar.[192]

**Aggressive**: Severe chemical exposure.

**Air Inhibition**: The prevention of complete polymerization (curing) of a reactive polymer due to the presence of air (oxygen).

**Bugholes**: Small regular or irregular cavities, usually not exceeding 15 mm in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and compaction.[192]

**Chemical Attack**: Decomposition of a coating or concrete due to the action of a chemical.

**Coating, Coating System**: A liquid or a liquid with fillers and/or reinforcement that is applied to a substrate and cures by heat or catalysts to form a thermoset polymer that will bond to and protect the substrate and provide a barrier to contain chemicals.

**Compatibility**: The ability of a coating to resist attack and permeation by a specific chemical within a specific time period.

**Concentration** (not stress concentration): Amount of a substance expressed in relationship to the whole.[193]

**Concrete**: A composite material that consists essentially of a binding medium within which are embedded particles or fragments of aggregate; in portland cement concrete, the binder is a mixture of portland cement and water.[192]

**Contaminant, Contamination**: Any extraneous material on the concrete surface that will affect the adhesion of the applied coating to the concrete.

**Contraction Joint**: Formed, sawed, or tooled groove in a concrete structure to create a weakened plane and regulate the location of cracking resulting from the dimensional change of different parts of the structure.[192]

**Crack**: See *Dynamic Crack* and *Static Crack*.

**Cross-Linking**: Applied to polymer molecules, the setting up of chemical links between the molecular chains to form a three-dimensional or network polymer, generally by covalent bonding. When extensive, as in most thermosetting resins, cross-linking makes one infusible larger molecule of all the linked chains. Cross-linking generally toughens and stiffens coatings. Thermosetting materials cross-link under the influence of heat and catalysis. It may also be inducted by the use of catalysts and/or electron curing.[193]

**Cure**: To change the properties of a polymeric system into a final, more stable, usable condition by the use of heat, radiation, or reaction with chemical additives.[193]

**Curing**: The toughening or hardening of a coating film as a result of elevated temperature or significant reaction other than oxidation.[193]

**Cure, Curing**: The maintenance of a satisfactory moisture content and temperature in concrete during its early stages so that desired properties may develop.[192]

**Curing Compound**: A liquid that can be applied as a coating to the surface of newly placed concrete to retard the loss of water and, in the case of pigmented compounds, to reflect heat which provides an opportunity for the concrete to develop its properties in a favorable temperature and moisture environment.[192]

Provided by : www.spic.ir Licensee: NISOC Library

**Disbondment**: The loss of adhesion between a coating and the substrate.

**Discontinuity**: See *Holiday*.

**Dynamic Crack**: A crack in the concrete surface whose width changes as the concrete moves.

**Efflorescence**: A white crystalline or powdery deposit on the surface of concrete. Efflorescence results from leaching of lime or calcium hydroxide out of a permeable concrete mass over time by water, followed by reaction with carbon dioxide and acidic pollutants.[194]

**Elastomer**: A natural or synthetic polymer which, at room temperature, can be stretched repeatedly to at least twice its original length and which, after removal of the tensile load, will immediately and forcibly return to approximately its original length.[193]

**Finish**: The texture of a concrete surface after compaction and finishing operations have been performed.[192]

**Finishing**: Leveling, smoothing, compacting, and otherwise treating surfaces of fresh or recently placed concrete or mortar to produce desired appearance and service.[192]

**Glass-Transition Temperature**: The temperature at which the noncrystalline portion of the polymer is transformed from a tough, rubbery material to a brittle, glass-like material.[193]

**Grout, Grouting**: A plastic mixture of cementitious materials and water used as a filler for cracks, or other void spaces, in concrete surfaces to be coated.[67]

**Hazardous Substance**: A substance which, by reason of being explosive, flammable, poisonous, corrosive, oxidizing, or otherwise harmful, is likely to cause death or injury when misused.

**Hazardous Waste**: A solid waste subject to RCRA regulations because it is specifically listed as one of the wastes to which regulations apply, or because it exhibits the characteristics which define a hazardous waste.

**High-Pressure Water Cleaning (HP WC)**: HP WC is cleaning performed at pressures from 34 to 70 MPa (5,000 psi to 10,000 psi).[55]

**High-Pressure Water Jetting (HP WJ)**: HP WJ is cleaning performed at pressures from 70 to 170 MPa (10,000 to 25,000 psi).[55]

**Holiday**: A discontinuity of the coating that exposes the substrate to the environment or exhibits electrical conductivity when exposed to a predetermined test voltage.

**Holiday Detector**: An electrical device that locates discontinuities in the protective coating.

**Honeycomb**: Voids left in concrete due to failure of the mortar to effectively fill the spaces among coarse aggregate particles.[192]

**Hydraulic, Hydrostatic Pressure**: A force exerted on the concrete/coating interface due to the level of the ground water.

**Hydrolysis**: A disruptive reaction consisting of splitting a compound into two parts, one of which combines with the $H^+$ ion of water and the other with the $OH^-$ ion of water.[193]

**Hydrophilic**: Substance which absorbs or exhibits affinity for water; wettable.[193]

**Hydrophobic**: Substance which does not absorb or exhibit affinity for water; nonwettable.[193]

**Initiator**: A reactive material that initiates a polymerization reaction but is not regenerated.

**Isolation Joint**: A separation between adjoining parts of a concrete structure.

**Joint**: See *Contraction Joint* and *Isolation Joint*.

**Laitance**: A thin, weak, brittle layer of cement and aggregate fines on a concrete surface. The amount of laitance is influenced by the degree of working or the amount of water in the concrete.[194]

**Lining, Lining System**: See *Coating*.

**Monolithic**: Seamless coating system.

**Osmotic Pressure**: A force exerted on the concrete/coating interface through the capillaries in the concrete due to a moisture differential across the coating.

**Permeability**: The time rate of water vapor transmission through unit area of flat material induced by unit vapor pressure difference between two specific surfaces, under specified temperature and humidity conditions.[122]

**Pinholes**: Film defect characterized by small pore-like flaws in a coating which extend entirely through the applied film and have the general appearance of

Provided by : www.spic.ir Licensee: NISOC Library

pin pricks, fine holes, or voids when viewed by reflected light.[193]

**Plastic Cracking, Plastic Shrinkage Cracking**: Cracking that occurs in the surface of fresh concrete soon after it is placed and while it is still plastic.[192]

**Porosity, Surface Porosity**: The ratio, usually expressed as a percentage, of the volume of voids in a material to the total volume of the material, including the voids.[192]

**Primary Containment**: The tank, pipe, or vessel used to store or transport a chemical.

**Profile, Surface Profile**: Surface contour as viewed from edge.

**Protective Barrier Coating System**: See *Coating.*

**Reflective Cracking**: Cracking that develops in a coating directly over a dynamic crack in the concrete.

**Reinforcement**: Fibers and fillers that improve the physical strength (primarily tensile strength) of the coating system. Fiberglass mat and flake fillers are commonly used reinforcements.

**Sealant, Joint Sealant**: Compressible material used to exclude water and solid foreign materials from joints.[192]

**Secondary Containment**: Structures capable of preventing product or waste stored in a tank, pipe, or vessel from migrating to soil, ground water, or surface water.

**Segregation**: The differential concentration of the components of mixed concrete, aggregate, or the like, resulting in nonuniform proportions in the mass.[192]

**Static Cracks**: A crack in the concrete surface whose width does not change.

**Surface Preparation**: The method or combination of methods used to clean a concrete surface, remove loose and weak materials and contaminants from the surface, repair the surface, and roughen the surface to promote adhesion of a protective coating or lining system.

**Thermal Expansion, Coefficient of Linear Thermal Expansion (CLTE)**: The relative measurement in one dimension of the movement within a material due to changes in temperature.

**Thermal Shock**: A rapid force exerted on a coating due to a sudden change in temperature.

**Thermoset, Thermoset Polymer**: A material which will undergo or has undergone a chemical reaction by the action of heat, catalysts, ultraviolet light, etc., leading to a relatively infusible state.[193]

**Vapor Barrier**: Waterproof membrane placed under concrete floor slabs that are placed on grade.[192]

**Water Vapor Transmission Rate (WVT)**: The steady water vapor flow in unit time through unit area of a body, between two specific parallel surfaces, under specific conditions of temperature and humidity at each surface.[193]

**Workability**: A measure of the ease of installation of a coating system.

## References

1. Environmental Protection Agency Publication 530-SW-86-044 (OSWER Policy Directive #9483.00-1). "Technical Resource Document for the Storage and Treatment of Hazardous Waste in Tank Systems" (Washington, D.C.: EPA, 1986).

2. U.S. Code of Federal Regulations (CFR) Title 40, "Protection of Environment," Part 260, "Hazardous Waste Management System: General," July 1, 1990.

3. U.S. CFR Title 40, "Protection of Environment," Part 264.193, "Containment and Detection of Releases," July 1, 1990.

4. "EPA Holds Forums to Discuss ASTs," Materials Performance 33, 2 (1994): pp. 13-14.

5. K. Kapsanis, "Coating Concrete: A Review of Regulations, Technical Activities, and Resources," Journal of Protective Coatings and Linings (JPCL) 8, 8 (1991): pp. 58-65.

6. M. Melody, J. Bishop, "Storage Tank Choices, Regulations," Hazmat World April (1992): pp. 30-41.

7. J.E. Pandolph, "AST Owners Face New Compliance Challenges," MP 33, 1 (1994): p. 49.

8. ACI 302.1R (latest revision), "Guide to Concrete Floor and Slab Construction" (Farmington Hills, MI: ACI).

9. ACI 350R (latest revision), "Environmental Engineering Concrete Structures" (Farmington Hills, MI: ACI).

Provided by : www.spic.ir Licensee: NISOC Library

10. ACI 350.2R (latest revision), "Concrete Structures Containing Hazardous Materials" (Farmington Hills, MI: ACI).

11. T. Dudick, "Concrete Standards for Resinous Toppings," in Innovations for Preserving and Protecting Industrial Structures, held November 13-18, 1993 (Pittsburgh, PA: SSPC, 1993).

12. ACI 209R (latest revision), "Prediction of Creep, Shrinkage and Temperature Effects in Concrete Structures" (Farmington Hills, MI: ACI).

13. ACI 305R (latest revision), "Hot Weather Concreting" (Farmington Hills, MI: ACI).

14. ACI 306R (latest revision), "Cold Weather Concreting" (Farmington Hills, MI: ACI).

15. ASTM C 150 (latest revision), "Specification for Portland Cement" (West Conshohocken, PA: ASTM).

16. ACI 308 (latest revision), "Standard Practice for Curing Concrete" (Farmington Hills, MI: ACI).

17. ASTM C 845 (latest revision), "Specification for Expansive Hydraulic Cement" (West Conshohocken, PA: ASTM).

18. ACI 223 (latest revision), "Standard Practice for the Use of Shrinkage Compensating Concrete" (Farmington Hills, MI: ACI).

19. ACI 504R (latest revision), "Guide to Joint Sealants for Concrete Structure" (Farmington Hills, MI: ACI).

20. ACI 224R (latest revision), "Control of Cracking in Concrete Structures" (Farmington Hills, MI: ACI).

21. ACI 224.1R (latest revision), "Causes, Evaluation, and Repair of Cracks in Concrete Structures" (Farmington Hills, MI: ACI).

22. ACI 224.2R (latest revision), "Cracking of Concrete Members in Direct Tension" (Farmington Hills, MI: ACI).

23. R.W. Dively, "Osmotic Blistering of Coatings and Linings Applied to Concrete Surfaces," MP 33, 5 (1994): pp. 42-44.

24. M. Gunter, H.K. Hilsdorf, "Stresses Due to Physical and Chemical Actions in Polymer Coatings on a Concrete Substrate," in Adhesion Between Polymers and Concrete: Bonding, Protection, Repair, ed. H.R. Sasse, RILEM Conference held at Aix-en-Provence, France, September 16-19, 1986, pp. 8-21.

25. W.H. Riesterer, "Hydrostatic, Capillary, Osmotic and Other Pressures," in Innovations for Preserving and Protecting Industrial Structures, held November 13-18, 1993 (Pittsburgh, PA: SSPC, 1993).

26. "Surface Preparation of Concrete" (Houston, TX: NACE, and Pittsburgh, PA: SSPC). Work in Progress by NACE/SSPC Joint Task Group F.

27. T.I. Aldinger, "Coating New Concrete: Why Wait 28 Days?" in Protective Coatings for Flooring and Other Concrete Surfaces, held November 10-15, 1991 (Pittsburgh, PA: SSPC, 1991), pp. 1-4.

28. H.H. Baker, R.G. Posgay, "The Relationship Between Concrete Cure and Surface Preparation," JPCL 8, 8 (1991): pp. 50-56.

29. ASTM C 309 (latest revision), "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete" (Philadelphia, PA: ASTM).

30. F. Hazen, "Repairing Concrete Prior to Lining Secondary Containment Structures," JPCL 8, 1 (1991): pp. 73-79.

31. R.A. Nixon, "Assessing the Deterioration of Concrete in Pulp and Paper Mills," in Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques (Houston, TX: NACE, 1991).

32. J. Steele, "Testing Adhesion of Coatings Applied to Concrete," MP 33, 11 (1994): pp. 33-36.

33. ASTM D 4541 (latest revision), "Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers" (West Conshohocken, PA: ASTM).

34. ACI 503R (latest revision) "Use of Epoxy Compounds with Concrete" (Farmington Hills, MI: ACI).

35. ICRI Publication No. 03730 (latest revision), "Surface Preparation Guidelines for the Repair of Deteriorated Concrete Resulting from Reinforced Steel Corrosion" (Sterling, VA: ICRI).

36. L. Harriman, "Drying and Measuring Moisture in Concrete—Part I" MP 34, 1 (1995): pp. 34-36.

37. L. Harriman, "Drying and Measuring Moisture in Concrete—Part II," MP 34, 2 (1995): pp. 55-59.

38. ASTM D 4263 (latest revision), "Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method" (West Conshohocken, PA: ASTM).

Provided by : www.spic.ir Licensee: NISOC Library

39. "Moisture Emission Test Unit Developed by Rubber Manufacturers Association Inc." (RMA test) (Sheboygen, WI: Vinyl Plastics Inc.).

40. BS 5325 (latest revision), "British Standard Code of Practice for Installation of Textile Floor Coverings," Appendix A, Dampness Testing (London, England: British Standards Institution).

41. NACE Publication 6F163, "Surface Preparation of Steel or Concrete Tank Interiors" (Houston, TX: NACE, 1963).

42. NACE Publication 6G166, "Surface Preparation of Concrete for Coating" (Houston, TX: NACE, 1966).

43. NACE Publication 6H175 (1986 edition), "Surface Preparation and Surfacing Materials for Cementitious Surfaces" (Houston, TX: NACE, 1986).

44. NACE Publication 6G191, "Surface Preparation of Contaminated Concrete for Corrosion Control" (Houston, TX: NACE, 1991).

45. ASTM C 811 (latest revision), "Standard Practice for Surface Preparation of Concrete for Application of Chemical-Resistant Resin Monolithic Surfacings" (West Conshohocken, PA: ASTM).

46. ICRI Guide No. 03732 (latest revision), "Guide for Selecting and Specifying Surface Preparation for Sealers, Coatings, and Membranes" (Sterling, VA: ICRI).

47. ACI 515.1R (latest revision), "Guide to the Use of Waterproofing, Dampproofing, Protective and Decorative Barrier Systems for Concrete" (Farmington Hills, MI: ACI).

48. T.I. Aldinger, B.S. Fultz, "Keys to Successfully Preparing Concrete for Coating," JPCL 6, 5 (1989): pp. 34-40.

49. N.C. Duvic, "Surface Preparation of Concrete for Application of Protective Surfacing or Coating," in Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques (Houston, TX: NACE, 1991).

50. ASTM D 4258 (latest revision), "Standard Practice for Surface Cleaning Concrete for Coating" (West Conshohocken, PA: ASTM).

51. PCA Publication IS214.02T, "Removing Stains and Cleaning Concrete Surfaces" (Skokie, IL: Portland Cement Association, 1988).

52. S. Lefkowitz, "Controlled Decontamination of Concrete," in Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques (Houston, TX: NACE, 1991).

53. F.S. Gelfant, "Contaminated Concrete—Effect of Surface Preparation Methods on Coating Performance," JPCL 12, 12 (1995): pp. 60-72.

54. ASTM D 4259 (latest revision), "Standard Practice for Abrading Concrete" (West Conshohocken, PA: ASTM).

55. NACE No. 5/SSPC-SP 12 (latest revision), "Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating" (Houston, TX: NACE).

56. Water Jet Technology Association, "Recommended Practices for the Use of Manually Operated High Pressure Water Jetting Equipment," 3rd ed. (St. Louis, MO: WJTA, 1994).

57. ISO 8501-1 (latest revision), "Preparation of Steel Substrates Before Application of Paints and Related Products—Visual Assessment of Surface Cleanliness" (Geneva, Switzerland: International Organization for Standardization).

58. ASTM D 4260 (latest revision), "Standard Practice for Acid Etching Concrete" (West Conshohocken, PA: ASTM).

59. ASTM C 722 (latest revision), "Standard Specification for Chemical-Resistant Resin Monolithic Surfacings" (West Conshohocken, PA: ASTM).

60. NACE Publication 6A187, "Reinforced Polyester and Epoxy Linings" (Houston, TX: NACE, 1987).

61. NACE Standard RP0376 (latest revision), "Monolithic Organic Corrosion Resistant Floor Surfacings" (Houston, TX: NACE).

62. NACE Standard RP0591 (latest revision), "Coatings for Concrete Surfaces in Non-Immersion and Atmospheric Service" (Houston, TX: NACE, 1991).

63. NACE Standard RP0892 (latest revision), "Linings over Concrete for Immersion Service" (Houston, TX: NACE).

64. NACE Publication TPC 2, Coatings and Linings for Immersion Service (Houston, TX: NACE, 1972).

65. C.G. Munger, Corrosion Prevention by Protective Coatings (Houston, TX: NACE, 1984).

66. J. Steele, "Successful Coating and Lining of Concrete," Student notebook for Successful Coating

Provided by : www.spic.ir Licensee: NISOC Library

and Lining of Concrete Seminar (Houston TX: NACE, 1994).

67. ASTM Publication PCN:03-401079-14, Manual of Nuclear Coating Work (West Conshohocken, PA: ASTM, 1979).

68. T.I. Aldinger, "Designing Secondary Containment and Other Concrete Structures to Optimize Coating Performance," JPCL 9, 8 (1992): pp. 46-54.

69. T.I. Aldinger, "Technical Specifications for Concrete Coatings Work," in Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques (Houston, TX: NACE, 1991).

70. A.A. Boova, "A Guide to Selecting Industrial Flooring Systems," JPCL 7, 2 (1990): pp. 36-44.

71. A.A. Boova, "Decorative Protective Flooring Systems," CORROSION/90, paper no. 346 (Houston, TX: NACE, 1990).

72. T. Dudick, "Selecting Resinous Linings and Coatings," Concrete Repair Bulletin 7, 5 (1994): pp. 7-10.

73. J.J. Glass, "Choosing a Flooring System to Protect Concrete from Aggressive Chemicals," JPCL 9, 2 (1992): pp. 65-68.

74. T.I. Aldinger, B.S. Fultz, "Selecting Coatings and Linings for Concrete in Chemical Environments," JPCL 12, 8 (1995): pp. 64-77.

75. J. Hendley, "Basic Criteria Evaluated for Successful Selection and Installation of Functional Coatings," in Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques (Houston, TX: NACE, 1991).

76. P.C. Hewlett, "Methods of Protecting Concrete," in Protection of Concrete, eds. R.K Dhir, J.W. Green, held September 11-13, 1990 (London, England: Chapman and Hall, 1990), pp. 105-134.

77. J. Jarboe, "Coatings and Linings for Wine-Making Facilities," JPCL 5, 8 (1988): pp. 28-35.

78. W.H. Julius, "Tips on Avoiding Coating Failures on Concrete," JPCL 10, 12 (1993): pp. 35-43.

79. R.L. McGown, "Protection of Concrete Substrates Using Protective Coatings: An Overview," in Protective Coatings for Flooring and Other Concrete Surfaces, held November 10-15, 1991 (Pittsburgh, PA: SSPC, 1991), pp. 46-52.

80. R.A. Nixon, R.H. DeWolf, "Protecting Concrete with Resinous Floor Toppings: An Owner's Guide," JPCL 9, 2 (1992): pp. 36-44.

81. R.A. Nixon, R.H. DeWolf, "Repairing and Protecting Concrete Floors in Industrial Facilities: An Owner's Guide for Avoiding Resinous Floor Topping Failures," in Protective Coatings for Flooring and Other Concrete Surfaces, held November 10-15, 1991 (Pittsburgh, PA: SSPC, 1991), pp. 125-150.

82. J.M. Pierce, "Coating Enhancement Procedures for Concrete Structures," in Achieving Quality in Coating Work, held November 19, 1992 (Pittsburgh, PA: 1992), pp. 173-174.

83. S. Poncio, D. Hall, "Experience Report on Coating of Concrete Containment Structures in a Maintenance Environment in Power Plants," in Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques (Houston, TX: NACE, 1991).

84. J.A. Redner, R.R. Hsi, E. Esfandi, "Evaluation of Protective Coatings for Concrete," in Protective Coatings for Flooring and Other Concrete Surfaces, held November 10-15, 1991 (Pittsburgh, PA: SSPC, 1991), pp. 93-124.

85. M. Schupack, "Divorces and Ruptured Relations Between Epoxies and Concrete," Concrete Construction October (1980): pp. 735-738.

86. J. Steele, "Coating Film Thickness in Concrete Sanitary Sewers: How Much is Enough?" MP 33, 9 (1994): pp. 39-41.

87. P.M. Young, "Protecting Concrete in Water and Wastewater Treatment Facilities," JPCL 6, 7 (1989): pp. 28-35.

88. U.S. CFR Title 40 "Protection of Environment," Part 265.443, Subpart W "Drip Pads—Design and Operating Requirements," July 1, 1990.

89. New York State Department of Environmental Conservation, Division of Spill Management, Chemical Bulk Storage Regulations, Part 599, "Standards for New and Substantially Modified Hazardous Substance Storage Facilities," August 11, 1994.

90. "Modern Plastics Encyclopedia '96," Modern Plastics 72, 12, (1995): p. B153

91. J.W. Prane, Sealants and Caulks (Philadelphia, PA: Federation of Societies for Coatings Technology, 1989).

92. Deutsches Institut fur Bautechnik (DIBt), "Constructions and Test Principles for Coatings for Concrete, Plaster, and Screed Surfaces of Collecting Rooms for Water-Endangered Liquids" (Berlin, Germany: DIBt, 1993).

Provided by : www.spic.ir Licensee: NISOC Library

93. M.C. Adshead, "Required Performance of Expansion Joint Materials," in Achieving Quality in Coating Work, held November 19, 1992 (Pittsburgh, PA: SSPC, 1992), pp.175-178.

94. T.D. Barkey, W.R. Slama, N.B. Fancher, "Physical and Mathematical Representations for the Determination of Crack-Bridging Ability of Lining Systems," in Managing Costs and Risks for Effective and Durable Protection, held November 11-17, 1994 (Pittsburgh, PA: SSPC, 1994), pp. 152-162.

95. L. Czarnecki, J. Grabowski, "Criterion of Cracking Resistance of Glass Fiber Reinforced Resins: A Comparative Study," in Adhesion Between Polymers and Concrete: Bonding, Protection, Repair, ed. H.R. Sasse, RILEM Conference held at Aix-en-Provence, France, September 16-19, 1986 (London, England: Chapman and Hall, 1986), pp. 152-165.

96. R.W. Dively, "Cracks in Concrete and Their Effect on Coatings and Linings," MP 33, 2 (1994): pp. 44-45.

97. T. Dudick, "New Method of Crack Treatment for Resinous Coatings," in Achieving Quality in Coating Work, held November 19, 1992 (Pittsburgh, PA: SSPC, 1992).

98. A.R. Fiorillo, "Joints for Secondary Containment," in Protective Coatings for Flooring and Other Concrete Surfaces, held November 10-15, 1991 (Pittsburgh, PA: SSPC, 1991), pp. 53-71.

99. F.S. Gelfant, "Design Considerations for Reinforced Thermoset Lining Systems Over Concrete," MP 33, 3 (1994): pp. 27-31.

100. J.L. Hausfeld, "Flexible Chemical Resistant Concrete Lining for Spill Containment," in Achieving Quality in Coating Work, held November 19, 1992 (Pittsburgh, PA: SSPC, 1992), pp. 155-164.

101. JPCL Staff, "Using Thermoset Linings to Bridge Concrete Cracks in Secondary Containment," JPCL 9, 8 (1992): pp. 75-76.

102. M.W. Klosinski, M.W. Abramowitz, W. Glinka, "Modeling the Work of Glass Fiber Reinforced Resin Coatings on a Cracked Surface of Concrete," in Adhesion Between Polymers and Concrete: Bonding, Protection, Repair, ed. H.R. Sasse, RILEM Conference held September 16-19, 1986 (London, England: Chapman and Hall, 1986), pp. 183-187.

103. L. Meilus, "Unique Flexible Epoxy Systems for Flooring and Secondary Containment," SPI, Epoxy Resin Formulators, 1993 Fall Conference, held at Toronto, Ont., November 1-3, 1993 (Washington, D.C.: The Society of the Plastics Industry, 1993), paper no. 7.

104. F.A. Pfaff, F.S. Gelfant, "Testing New Crack-Bridging Designs Used in Lining Systems Over Concrete," in Innovations for Preserving and Protecting Industrial Structures, held November 13-18, 1993 (Pittsburgh, PA: SSPC, 1993), pp. 126-139.

105. B. Schwanborn, M. Fiebrich, "Crack-Bridging Behavior of Protective Coatings Subjected to Natural Weathering," in Protection of Concrete, eds. R.K Dhir, J.W. Green, held September 11-13, (London, England: Chapman and Hall, 1990), pp. 245-255.

106. J.W. Sherick, "Expansion Joints for Containment Vessels," in Innovations for Preserving and Protecting Industrial Structures, held at New Orleans, LA, November 13-18, (Pittsburgh, PA: SSPC, 1993), pp. 123-125.

107. V. Weiss, "Behavior of Tougher Coating with Concrete under Different Types of Loading," in Adhesion Between Polymers and Concrete: Bonding, Protection, Repair, ed. H.R. Sasse, RILEM Conference held September 16-19, 1986 (London, England: Chapman and Hall, 1986), pp. 289-296.

108. L. Xian-Neng, "Study on the Use of Crack Resistant Polyester Mortars as Anticorrosion Coatings for Outdoor Concrete," in Adhesion Between Polymers and Concrete: Bonding, Protection, Repair, ed. H.R. Sasse, RILEM Conference held September 16-19, 1986 (London, England: Chapman and Hall, 1986), pp. 188-193.

109. ASTM C 868 (latest revision), "Test Method for Chemical Resistance of Protective Linings" (West Conshohocken, PA: ASTM).

110. NACE Standard TM0174 (latest revision), "Laboratory Methods for the Evaluation of Protective Coatings Used as Lining Materials in Immersion Service" (Houston, TX: NACE).

111. ASTM D 4398 (latest revision), "Test Method for Determining the Chemical Resistance of Fiberglass-Reinforced Thermosetting Resins by One-Sided Panel Exposure" (West Conshohocken, PA: ASTM).

112. ASTM C 267 (latest revision), "Test Method for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings" (West Conshohocken, PA: ASTM).

113. ASTM C 413 (latest revision), "Test Method for Absorption of Chemical-Resistant Mortars, Grouts and Monolithic Surfacings" (West Conshohocken, PA: ASTM).

114. ASTM D 543 (latest revision), "Test Method for Resistance of Plastics to Chemical Reagents" (West Conshohocken, PA: ASTM).

Provided by : www.spic.ir Licensee: NISOC Library

115. ASTM C 307 (latest revision), "Test Method for Tensile Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings" (West Conshohocken, PA: ASTM).

116. ASTM D 412 (latest revision), "Test Methods for Rubber Properties in Tension" (West Conshohocken, PA: ASTM).

117. ASTM D 638 (latest revision), "Test Method for the Tensile Properties of Plastic" (West Conshohocken, PA: ASTM).

118. ASTM C 580 (latest revision), "Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings" (West Conshohocken, PA: ASTM).

119. ASTM C 579 (latest revision), "Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes" (West Conshohocken, PA: ASTM).

120. ASTM D 5045 (latest revision), "Test Method for Plane-Strain Fracture Toughness and Strain Energy Release Rate of Plastic Materials" (West Conshohocken, PA: ASTM).

121.ASTM D 2794 (latest revision), "Test Method for the Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)" (West Conshohocken, PA: ASTM).

122. ASTM E 96 (latest revision), "Water Vapor Transmission of Materials" (West Conshohocken, PA: ASTM).

123. ASTM C 531 (latest revision), "Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings" (West Conshohocken, PA: ASTM).

124. ASTM C 883 (latest revision), "Effective Shrinkage of Epoxy-Resin Systems Used with Concrete" (West Conshohocken, PA: ASTM).

125. ASTM C 884 (latest revision), "Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay" (West Conshohocken, PA: ASTM).

126. ASTM E 1356 (latest revision), "Test Method for Glass Transition Temperature by Differential Scanning Calorimetry or Differential Thermal Analysis" (West Conshohocken, PA: ASTM).

127. ASTM D 4587 (latest revision), "Tests on Paints and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water-Exposure Apparatus" (West Conshohocken, PA: ASTM).

128. D.J. De Renzo, ed., Corrosion Resistant Materials Handbook, 4th ed. (Park Ridge, NJ: Noyes Data Corporation, 1985).

129. D.J. De Renzo, ed., Handbook of Corrosion Resistant Coatings (Park Ridge, NJ: Noyes Data Corporation, 1986).

130. C.H. Hare, Protective Coatings, Fundamentals of Chemistry and Composition (Pittsburgh, PA: SSPC, 1994).

131. W.S. Sheppard Jr., Chemically Resistant Masonry, 2nd ed. (New York, NY: Marcel Dekker, 1982).

132. "Steel Structures Painting Manual, Volume 2, Systems and Specifications," 7th ed. (Pittsburgh, PA: SSPC, 1995).

133. P.H. Anderson, "Polysulfide Coatings in Secondary Containment," in Innovations for Preserving and Protecting Industrial Structures, held November 13-18, 1993 (Pittsburgh, PA: SSPC, 1993), pp.140-143.

134. A.A. Boova, "Thermoplastic Linings for Protecting Concrete and Steel," JPCL 5, 11 (1988): pp. 38-47.

135. A.A. Boova, "Thermoplastic Linings Mechanically Bonded to Concrete," MP 31, 4 (1992): pp. 34-38.

136. R.J. Franco, T.W. Ford, S. Fenwick, "Fiberglass Lining of a Concrete Neutralization Pit," in Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques (Houston, TX: NACE, 1991).

137. F.S. Gelfant, "A Historical Perspective on the Advancement of Coating Technology for the Protection of Concrete," CORROSION/93, paper no. 445, (Houston, TX: NACE, 1993).

138. T.K. Greenfield, "Specifying Coatings for Concrete Surfaces," MP 33, 7 (1994): pp. 37-41.

139. D. Griffin, "Coating of Concrete," in Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques (Houston, TX: NACE, 1991).

140. F. Hazen, "Corrosion Proofing of Concrete Structures in Pulp and Paper Mills," in Innovations for Preserving and Protecting Industrial Structures, held November 13-18, 1993 (Pittsburgh, PA: SSPC, 1993), pp. 16-34.

141. F. Hazen, "Monolithic Linings and Coatings for Chemical Secondary Containment Structures," in Protective Coatings for Flooring and Other Concrete

Provided by : www.spic.ir Licensee: NISOC Library

Surfaces, held November 10-15, 1991 (Pittsburgh, PA: SSPC, 1991), pp. 72-92.

142. F.E. Hazen, "Monolithic Linings and Coatings for Chemical Secondary Containment Structures," MP 30, 8 (1991): pp. 36-41.

143. D.J. Herzog, T.B Brown, "Proper Cure of Vinyl Ester Resins," MP 33, 4 (1994): pp. 30-33.

144. W.H. Julius, S.S. McDowell, "Continuous Needle Punched Non-Woven Polyester Fabric for Improvement of Corrosion Resistance and Thermal Shock of Reinforced Monolithic Coatings for Concrete," in Innovations for Preserving and Protecting Industrial Structures, held November 13-18, 1993 (Pittsburgh, PA: SSPC, 1993), pp. 119-122.

145. M.J. Masciale, R.T. Cash, "Coatings for Concrete Floors," in Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques (Houston, TX: NACE, 1991).

146. L. Matson, "Improve Secondary Containment," Hydrocarbon Processing 70, 3 (1991): pp. 73-75.

147. T. Millard, "Epoxy and Vinyl Ester Flooring for Concrete," JPCL 5, 8 (1988): pp. 36-47.

148. P.R. Nau, B.S. Fultz, "Coatings and Linings for Secondary Containment in Power Plants," JPCL 7, 10 (1990): pp. 42-49.

149. F. Neville, E.J. Wolf, "Monolithic Linings and Floorings for the Pulp and Paper Industry," JPCL 8, 8 (1991): pp. 44-48.

150. D.T. Nguyen, et al., "Performance of Coatings for Concrete Secondary Containment Exposed to Pesticides," in Managing Costs and Risks for Effective and Durable Protection, held November 11-17, 1994 (Pittsburgh, PA: SSPC, 1994), pp. 129-151.

151. G. Ramirez, R. McGown, "The Use of Sprayable Elastomeric Polyurethane as a Secondary Containment Lining on Concrete," in Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques (Houston, TX: NACE, 1991).

152. A.H. Roebuck, R.W. Foster, "100 Percent Solids Plural Component Urethane Coatings," JPCL 5, 2 (1988): pp. 22-27.

153. R.R. Roesler, W. Cibulas, M.B. Bassi, "Polyurethanes: Low VOC Coatings for Concrete," presented at Protective Coatings for Flooring and Other Concrete Surfaces, held November 10-15, 1991 (Pittsburgh, PA: SSPC, 1991),

154. B.F. Schafran, C.W. Armstrong, "Repair and Maintenance of Refrigerated Warehouse Floors," JPCL 8, 3 (1991): pp. 60-64.

155. R. Stavinoha, "Coatings for Secondary Containment," in Achieving Quality in Coating Work, held November 19, 1992 (Pittsburgh, PA: SSPC, 1992), pp. 87-95.

156. R. Stavinoha, "Protecting Concrete from Exposure to Aggressive Chemicals," JPCL 5, 2 (1988): pp. 28-32.

157. R.W. Washburn, M.J. Galloway, W.R Slama, "Reinforced, Chemical-Resistant, Thermoset Linings," JPCL 2, 10 (1985): pp. 30-42.

158. T.D. Wayt, M.B. Bassi, "Polyurethane Coatings for Concrete," in Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques (Houston, TX: NACE, 1991).

159. M.P. Whitesell, T. Ippoliti, "Concrete Secondary Containment and Coatings," in Managing Costs and Risks for Effective and Durable Protection, held November 11-17, 1994 (Pittsburgh, PA: SSPC, 1994), pp. 173-178.

160. F.D. Wilson, "The Right Material for the Right Job," MP 29, 2 (1990): pp. 32-35.

161. ACI 503.3 (latest revision), "Producing a Skid Resistant Surface on Concrete by the Use of a Multi-Component Epoxy System" (Farmington Hills, MI: ACI).

162. D.J. Keehan, J.F. McIntyre, "Properties of an Inorganic/Organic Protective Coating for Use in Severe Service Environments," in Balancing Economics and Compliance for Maintaining Protective Coatings (Pittsburgh, PA: SSPC, 1995), pp. 70-74.

163. M.S. Gilbert, "Novel Siloxane Hybrid Resins for Use in Secondary Containment," in Balancing Economics and Compliance for Maintaining Protective Coatings (Pittsburgh, PA: SSPC, 1995), pp. 358-364.

164. R.L. Iazetti, "Reliable Crack-Bridging Secondary Containment Linings for Concrete Structures," SSPC 96 (S-10), Charlotte, NC, Nov. 1996.

165. Plastics Design Library Handbooks, Chemical Resistance, Volume 1: Thermoplastics, (Norwich, NY: Plastics Design Library, 1994).

166. Plastics Design Library Handbooks, Chemical Resistance, Volume 2: Thermoplastic Elastomers, Thermosets, and Rubbers (Norwich, NY: Plastics Design Library, 1994).

Provided by : www.spic.ir Licensee: NISOC Library

167. P.A. Schweitzer, ed., Corrosion Resistance Tables, 3rd ed., Part A (A-I), (New York, NY: Marcel Dekker, 1991).

168. P.A. Schweitzer, ed., Corrosion Resistance Tables, 3rd ed., Part B (J-Z), (New York, NY: Marcel Dekker, 1991).

169. N.L. Hancox, R.M. Mayer, eds., Design Data for Reinforced Plastics, A Guide for Engineers and Designers (New York, NY: Chapman and Hall, 1994).

170. T. Aldinger, "Concrete Coating Work Procedures" in Achieving Quality in Coating Work, held November 19, 1992 (Pittsburgh, PA: SSPC, 1992), pp. 80-86.

171. T.I. Aldinger, "The Modern Contractor: Writing Effective Work Procedures for Coating Concrete," JPCL 10, 1 (1993): pp. 46-55.

172. J. Arnold, "Management Procedures for Maintenance Painting of Industrial Floors," JPCL 6, 5 (1989): pp. 41-45.

173. R. Boyd, "Quality Control in Cleaning and Coating Concrete," in Protective Coatings for Flooring and Other Concrete Surfaces, held November 10-15, 1991 (Pittsburgh, PA: SSPC, 1991), pp. 5-7.

174. S. G. Pinney, "Preparation, Application, and Inspection of Coatings for Concrete," in Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques (Houston, TX: NACE, 1991).

175. T.K. Greenfield, "Dehumidification Equipment Reduces Moisture in Concrete During Coating Application," MP 33, 3 (1994): pp. 39-40.

176. ACI 503.2 (latest revision), "Repairing Concrete with Epoxy Mortars" (Farmington Hills, MI: ACI).

177. C.J. Steele, "Effective Sealing, Priming and Coating of New and Uncured Concrete," in Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques (Houston, TX: NACE, 1991).

178. "Steel Structures Painting Manual, Volume 1, Good Painting Practice," 7th ed. (Pittsburgh, PA: SSPC, 1994).

179. SSPC Publication 91-12, "Coating and Lining Inspection Manual" (Pittsburgh, PA: SSPC, 1991).

180. T.K. Greenfield, "Inspection of Coatings Applied to Concrete," MP 31, 10 (1992): pp. 32-35.

181. NACE Standard RP0288 (latest revision), "Inspection of Linings on Steel and Concrete," (Houston, TX: NACE).

182. ASTM D 4414 (latest revision), "Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gauges," (West Conshohocken, PA: ASTM).

183. ASTM D 4138 (latest revision), "Test Method for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive Means," (Philadelphia, PA: ASTM).

184. "Test Method for Nondestructive Meaurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gauge" (West Conshohocken, PA: ASTM). Work in progress by Committee D01.23.

185. D.D. Byerley, "Electrical Inspection of Protective Coatings Applied to Concrete," in Concrete: Surface Preparation, Coatings and Linings, and Inspection Techniques (Houston, TX: NACE, 1991).

186. ASTM D 4787 (latest revision), "Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates" (West Conshohocken, PA: ASTM).

187. NACE Standard RP0188 (latest revision), "Discontinuity (Holiday) Testing of Protective Coatings" (Houston, TX: NACE).

188. ASTM D 2583 (latest revision), "Test Method for the Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor" (West Conshohocken, PA: ASTM).

189. ASTM D 5402 (latest revision), "Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs" (West Conshohocken, PA: ASTM).

190. NACE Standard RP0184 (latest revision), "Repair of Lining Systems" (Houston, TX: NACE).

191. F. Hazen, "Repair and Resurfacing of Paper Mill Bleach Plant Floors," in Protective Coatings for Flooring and Other Concrete Surfaces, held at Long Beach, CA, November 10-15, (Pittsburgh, PA: SSPC, 1991), pp. 151-167.

192. ACI 116 (latest revision), "Cement and Concrete Terminology" (Farmington Hills, MI: ACI).

193. S. LeSota, ed., Coatings Encyclopedic Dictionary. (Blue Bell, PA: Federation of Societies for Coatings Technology, 1995).

194. "SSPC Guide for Applying Coatings to Concrete" (Pittsburgh, PA: SSPC). Work in progress by Committee C.1.6.

Provided by : www.spic.ir Licensee: NISOC Library

## Appendix A—Chemical Conditions

Table A1 gives the typical chemical resistance of generic secondary containment coating systems. This table provides general information only. This table is not intended to provide guidelines or serve as the basis for a specification. The coating manufacturer can be consulted to determine the appropriateness of a coating system to a particular application.

**TABLE A1**
**Typical Chemical Resistance of Secondary Containment Coating Systems**

| Chemical Type[A] | Concentration | Temperature | Contact Time | Polymer Types Used[B] |
|---|---|---|---|---|
| Inorganic Acid | Up to 10% | Up to 40°C | 72 hr Max. | All |
| Inorganic Acid | Medium | Up to 40°C | 72 hr Max. | All |
| Inorganic Acid | Concentrated | Up to 40°C | 72 hr Max. | 1,2,3,7,8 (Specific chemicals and formulas only) |
| Inorganic Acid | Up to 10% | 40°C to 70°C | 72 hr Max. | All |
| Inorganic Acid | Medium | 40°C to 70°C | 72 hr Max. | 1,2,3,7,8 (Specific chemicals and formulas only) |
| Inorganic Acid | Concentrated | 40°C to 70°C | 72 hr Max. | 1,2,3,7,8 (Specific chemicals and formulas only) |
| Inorganic Acid | Up to 10% | 70°C to 100°C | 72 hr Max. | 1,2,3,7 (Specific chemicals and formulas only) |
| Inorganic Acid | Medium | 70°C to 100°C | 72 hr Max. | 1,2,3,7 (Specific chemicals and formulas only) |
| Inorganic Acid | Concentrated | 70°C to 100°C | 72 hr Max. | None |
| Organic Acid | Up to 10% | Up to 40°C | 72 hr Max. | All |
| Organic Acid | 10% to 50% | Up to 40°C | 72 hr Max. | All |
| Organic Acid | 50% to 100% | Up to 40°C | 72 hr Max. | 2,3,7,8 |
| Organic Acid | Up to 10% | 40°C to 70°C | 72 hr Max. | All |
| Organic Acid | 10% to 50% | 40°C to 70°C | 72 hr Max. | 2,3,7,8 |
| Organic Acid | 50% to 100% | 40°C to 70°C | 72 hr Max. | 7,8 |
| Organic Acid | Up to 10% | 70°C to 100°C | 72 hr Max. | 2,3,7 |
| Organic Acid | 10% to 50% | 70°C to 100°C | 72 hr Max. | 2,3,7 |
| Organic Acid | 50% to 100% | 70°C to 100°C | 72 hr Max. | 7 |
| Oxidizer | Up to 10% | Up to 40°C | 72 hr Max. | All |
| Oxidizer | Medium | Up to 40°C | 72 hr Max. | 1,2,3,8 |
| Oxidizer | Concentrated | Up to 40°C | 72 hr Max. | 2,8 (Specific chemicals and formulas only) |
| Oxidizer | Up to 10% | 40°C to 70°C | 72 hr Max. | 2,8 (Specific chemicals and formulas only) |
| Oxidizer | Medium | 40°C to 70°C | 72 hr Max. | 2,8 (Specific chemicals and formulas only) |
| Oxidizer | Concentrated | 40°C to 70°C | 72 hr Max. | 2,8 (Specific chemicals and formulas only) |
| Oxidizer | Up to 10% | 70°C to 100°C | 72 hr Max. | 2 (Specific chemicals and formulas only) |
| Oxidizer | Medium | 70°C to 100°C | 72 hr Max. | None |
| Oxidizer | Concentrated | 70°C to 100°C | 72 hr Max. | None |
| Alkalis | Up to 10% | Up to 40°C | 72 hr Max. | All |
| Alkalis | 10% to 40% | Up to 40°C | 72 hr Max. | All |
| Alkalis | Above 40% | Up to 40°C | 72 hr Max. | 1,2,3,6,7,8 (Specific chemicals and formulas only) |
| Alkalis | Up to 10% | 40°C to 70°C | 72 hr Max. | All |
| Alkalis | 10% to 40% | 40°C to 70°C | 72 hr Max. | 1,2,3,6,7,8 (Specific chemicals and formulas only) |
| Alkalis | Above 40% | 40°C to 70°C | 72 hr Max. | 1,2,3,6,7,8 (Specific chemicals and formulas only) |

[A] See Appendix C for examples of chemicals in each classification.
[B] 1 = epoxy; 2 = polyester; 3 = vinyl ester; 4 = polyurethane/polyurea; 5 = polysulfide; 6 = acrylic; 7 = furan; 8 = epoxy siloxane

Provided by : www.spic.ir Licensee: NISOC Library

| Chemical Type[A] | Concentration | Temperature | Contact Time | Polymer Types Used[B] |
|---|---|---|---|---|
| Alkalis | Up to 10% | 70°C to 100°C | 72 hr Max. | 1,2,3,7 (Specific chemicals and formulas only) |
| Alkalis | 10% to 40% | 70°C to 100°C | 72 hr Max. | 1,2,3,7 (Specific chemicals and formulas only) |
| Alkalis | Above 40% | 70°C to 100°C | 72 hr Max. | 1,2,3,7 (Specific chemicals and formulas only) |
| Chlorinated Solvents | Concentrated | Up to 40°C | 72 hr Max. | All (Specific chemicals and formulas only) |
| Chlorinated Solvents | Concentrated | 40°C to 70°C | 72 hr Max. | 1,2,3,7,8 (Specific chemicals and formulas only) |
| Chlorinated Solvents | Concentrated | 70°C to 100°C | 72 hr Max. | None |
| Oxygenated Solvents | Concentrated | Up to 40°C | 72 hr Max. | All (Specific chemicals and formulas only) |
| Oxygenated Solvents | Concentrated | 40°C to 70°C | 72 hr Max. | 1,2,3,7,8 (Specific chemicals and formulas only) |
| Oxygenated Solvents | Concentrated | 70°C to 100°C | 72 hr Max. | 1,2,3,7 (Specific chemicals and formulas only) |
| Hydrocarbon Solvents | Concentrated | Up to 40°C | 72 hr Max. | All (Specific chemicals and formulas only) |
| Hydrocarbon Solvents | Concentrated | 40°C to 70°C | 72 hr Max. | All (Specific chemicals and formulas only) |
| Hydrocarbon Solvents | Concentrated | 70°C to 100°C | 72 hr Max. | 1,2,3,7 (Specific chemicals and formulas only) |
| Salt Solutions | Saturated | Up to 40°C | 72 hr Max. | All |
| Salt Solutions | Saturated | 40°C to 70°C | 72 hr Max. | All |
| Salt Solutions | Saturated | 70°C to 100°C | 72 hr Max. | 1,2,3,7 (Specific chemicals and formulas only) |
| Inorganic Acid | Up to 10% | Up to 40°C | Continuous | All |
| Inorganic Acid | Medium | Up to 40°C | Continuous | All |
| Inorganic Acid | Concentrated | Up to 40°C | Continuous | 1,2,3,7 (Specific chemicals and formulas only) |
| Inorganic Acid | Up to 10% | 40°C to 70°C | Continuous | All |
| Inorganic Acid | Medium | 40°C to 70°C | Continuous | 1,2,3,7 (Specific chemicals and formulas only) |
| Inorganic Acid | Concentrated | 40°C to 70°C | Continuous | 1,2,3,7 (Specific chemicals and formulas only) |
| Inorganic Acid | Up to 10% | 70°C to 100°C | Continuous | 1,2,3,7 (Specific chemicals and formulas only) |
| Inorganic Acid | Medium | 70°C to 100°C | Continuous | 1,2,3,7 (Specific chemicals and formulas only) |
| Inorganic Acid | Concentrated | 70°C to 100°C | Continuous | None |
| Organic Acid | Up to 10% | Up to 40°C | Continuous | All |
| Organic Acid | 10% to 50% | Up to 40°C | Continuous | All |
| Organic Acid | 50% to 100% | Up to 40°C | Continuous | 2,3,7 |
| Organic Acid | Up to 10% | 40°C to 70°C | Continuous | All |
| Organic Acid | 10% to 50% | 40°C to 70°C | Continuous | 2,3,7 |
| Organic Acid | 50% to 100% | 40°C to 70°C | Continuous | None |
| Organic Acid | Up to 10% | 70°C to 100°C | Continuous | 2,3,7 |
| Organic Acid | 10% to 50% | 70°C to 100°C | Continuous | 2,3,7 |
| Organic Acid | 50% to 100% | 70°C to 100°C | Continuous | None |
| Oxidizer | Up to 10% | Up to 40°C | Continuous | All |
| Oxidizer | Medium | Up to 40°C | Continuous | 1,2,3 |

[A] See Appendix C for examples of chemicals in each classification.
[B] 1 = epoxy; 2 = polyester; 3 = vinyl ester; 4 = polyurethane/polyurea; 5 = polysulfide; 6 = acrylic; 7 = furan; 8 = epoxy siloxane

Provided by : www.spic.ir Licensee: NISOC Library

| Chemical Type[A] | Concentration | Temperature | Contact Time | Polymer Types Used[B] |
|---|---|---|---|---|
| Oxidizer | Concentrated | Up to 40°C | Continuous | 2 (Specific chemicals and formulas only) |
| Oxidizer | Up to 10% | 40°C to 70°C | Continuous | 2 (Specific chemicals and formulas only) |
| Oxidizer | Medium | 40°C to 70°C | Continuous | 2 (Specific chemicals and formulas only) |
| Oxidizer | Concentrated | 40°C to 70°C | Continuous | None |
| Oxidizer | Up to 10% | 70°C to 100°C | Continuous | 2 (Specific chemicals and formulas only) |
| Oxidizer | Medium | 70°C to 100°C | Continuous | None |
| Oxidizer | Concentrated | 70°C to 100°C | Continuous | None |
| Alkalis | Up to 10% | Up to 40°C | Continuous | All |
| Alkalis | 10% to 40% | Up to 40°C | Continuous | All |
| Alkalis | Above 40% | Up to 40°C | Continuous | 1,2,3,6,7 (Specific chemicals and formulas only) |
| Alkalis | Up to 10% | 40°C to 70°C | Continuous | All |
| Alkalis | 10% to 40% | 40°C to 70°C | Continuous | 1,2,3,6,7 (Specific chemicals and formulas only) |
| Alkalis | Above 40% | 40°C to 70°C | Continuous | 1,2,3,6,7 (Specific chemicals and formulas only) |
| Alkalis | Up to 10% | 70°C to 100°C | Continuous | 1,2,3,7 (Specific chemicals and formulas only) |
| Alkalis | 10% to 40% | 70°C to 100°C | Continuous | 1,2,3,7 (Specific chemicals and formulas only) |
| Alkalis | Above 40% | 70°C to 100°C | Continuous | 1,2,3,7 (Specific chemicals and formulas only) |
| Chlorinated Solvents | Concentrated | Up to 40°C | Continuous | All (Specific chemicals and formulas only) |
| Chlorinated Solvents | Concentrated | 40°C to 70°C | Continuous | None |
| Chlorinated Solvents | Concentrated | 70°C to 100°C | Continuous | None |
| Oxygenated Solvents | Concentrated | Up to 40°C | Continuous | All (Specific chemicals and formulas only) |
| Oxygenated Solvents | Concentrated | 40°C to 70°C | Continuous | 1,2,3,7 (Specific chemicals and formulas only) |
| Oxygenated Solvents | Concentrated | 70°C to 100°C | Continuous | None |
| Hydrocarbon Solvents | Concentrated | Up to 40°C | Continuous | All (Specific chemicals and formulas only) |
| Hydrocarbon Solvents | Concentrated | 40C to 70°C | Continuous | All (Specific chemicals and formulas only) |
| Hydrocarbon Solvents | Concentrated | 70°C to 100°C | Continuous | 1,2,3,7 (Specific chemicals and formulas only) |
| Salt Solutions | Saturated | Up to 40°C | Continuous | All |
| Salt Solutions | Saturated | 40°C to 70°C | Continuous | All |
| Salt Solutions | Saturated | 70°C to 100°C | Continuous | 1,2,3,7 (Specific chemicals and formulas only) |

[A] See Appendix C for examples of chemicals in each classification.
[B] 1 = epoxy; 2 = polyester; 3 = vinyl ester; 4 = polyurethane/polyurea; 5 = polysulfide; 6 = acrylic; 7 = furan; 8 = epoxy siloxane

Provided by : www.spic.ir Licensee: NISOC Library

## Appendix B—Physical Conditions

Table B1 lists generic secondary containment coating systems that have been used successfully in various environmental and service conditions. This table provides general information only. This table is not intended to provide guidelines or serve as the basis for a specification. The coating manufacturer can be consulted to determine the appropriateness of a coating system to a particular application.

**TABLE B1**
**Typical Conditions of Use of Secondary Containment Systems**

| Ambient Temperature Range | Conditions of Use | Physical Properties Required | System Designs Used |
|---|---|---|---|
| Low (22°C ± 10°C) | Occasional Foot | | All |
| Low (22°C ± 10°C) | Constant Foot | Abrasion Resistant | All |
| Low (22°C ± 10°C) | Fork Lift | Abrasion and Gouge Resistant | All |
| Low (22°C ± 10°C) | Drum Storage | Creep and Impact Resistant | All |
| Low (22°C ± 10°C) | Process Area | | All |
| Low (22°C ± 10°C) | Tank Storage | | All |
| Low (22°C ± 10°C) | Heavy Traffic | High Strength | Filled |
| Medium (22°C ± 20°C) | Occasional Foot | | All |
| Medium (22°C ± 20°C) | Constant Foot | Abrasion Resistant | All |
| Medium (22°C ± 20°C) | Fork Lift | Abrasion and Gouge Resistant | All |
| Medium (22°C ± 20°C) | Drum Storage | Creep and Impact Resistant | All |
| Medium (22°C ± 20°C) | Process Area | | All |
| Medium (22°C ± 20°C) | Tank Storage | | All |
| Medium (22°C ± 20°C) | Heavy Traffic | High Strength | Filled |
| Wider (22°C ± 30°C) | Occasional Foot | Crack Resistant | Reinforced or Elastomeric |
| Wider (22°C ± 30°C) | Constant Foot | Crack and Abrasion Resistant | Reinforced or Elastomeric |
| Wider (22°C ± 30°C) | Fork Lift | Crack, Abrasion, Gouge Resistant | Filled, Reinforced |
| Wider (22°C ± 30°C) | Drum Storage | Crack, Creep, Impact Resistant | Reinforced or Elastomeric |
| Wider (22°C ± 30°C) | Process Area | Crack Resistant | Reinforced or Elastomeric |
| Wider (22°C ± 30°C) | Tank Storage | Crack Resistant | Reinforced or Elastomeric |
| Wider (22°C ± 30°C) | Heavy Traffic | High Strength and Crack Resistant | Filled, Reinforced |
| Extreme (22°C > ±30°C) | Occasional Foot | Crack Resistant | Reinforced or Elastomeric |
| Extreme (22°C > ±30°C) | Constant Foot | Crack and Abrasion Resistant | Reinforced or Elastomeric |
| Extreme (22°C > ±30°C) | Fork Lift | Crack, Abrasion, Gouge Resistant | Filled, Reinforced |
| Extreme (22°C > ±30°C) | Drum Storage | Crack, Creep, Impact Resistant | Reinforced or Elastomeric |
| Extreme (22°C > ±30°C) | Process Area | Crack Resistant | Reinforced or Elastomeric |
| Extreme (22°C > ±30°C) | Tank Storage | Crack Resistant | Reinforced or Elastomeric |
| Extreme (22°C > ±30°C) | Heavy Traffic | High Strength and Crack Resistant | Filled, Reinforced |

Provided by : www.spic.ir Licensee: NISOC Library

## Appendix C—Examples of Chemicals Within Each Type

C1.1 The following lists provide examples of typical chemicals in each chemical type in Section 2 and Appendix A.

C1.1.1 Mineral Acids

(1) Sulfuric
(2) Nitric
(3) Hydrochloric
(4) Hydrofluoric
(5) Phosphoric
(6) Chromic

C1.1.2 Organic Acids

(1) Formic
(2) Acetic
(3) Acrylic
(4) Adipic
(5) Terephthalic
(6) Fatty Acids

C1.1.3 Oxidizers and Oxidizing Acids

(1) Nitric Acid
(2) Chromic Acid
(3) Peroxides
(4) Hypochlorites

C1.1.4 Alkalis

(1) Sodium Hydroxide
(2) Calcium Hydroxide
(3) Ammonia

C1.1.5 Chlorinated Solvents

(1) Methylene Chloride
(2) Ethylene Dichloride

C1.1.6 Oxygenated Solvents (often sub-divided as follows):

C1.1.6.1 Alcohols

(1) Methanol
(2) Ethanol
(3) Ethylene Glycol
(4) Phenol

C1.1.6.2 Ethers

(1) Diethyl Ether
(2) Glycol Ethers
(3) Propylene Oxide

C1.1.6.3 Ketones

(1) Acetone
(2) Methyl Ethyl Ketone

C1.1.6.4 Esters

(1) Vinyl Acetate
(2) Butyl Acetate

C1.1.7 Hydrocarbon Solvents (often sub-divided as follows):

C1.1.7.1 Aliphatic

(1) Butane
(2) Hexane
(3) Cyclohexane
(4) Butadiene

C1.1.7.2 Aromatic

(1) Benzene
(2) Ethylbenzene
(3) Styrene
(4) Xylene
(5) Toluene
(6) Cumene

C1.1.8 Salt Solutions

C1.1.9 Pesticides and Herbicides

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC: The Society for Protective Coatings
# TECHNOLOGY UPDATE NO. 3
## Overcoating

## 1. Scope

**1.1** This technology update discusses the risks associated with the maintenance painting practice known as overcoating. Factors affecting overcoating application, service and costs are discussed.

**1.2** This document is intended to serve as a resource for facility owners and others charged with developing and implementing maintenance painting programs.

**1.3** Overcoating is one of several maintenance painting options. This document is not intended to provide a detailed description or comparison of the relative merit and cost considerations of overcoating versus other maintenance painting options. For a more complete and detailed discussion of maintenance painting practices, the reader should refer to SSPC-PA Guide 5, Guide to Maintenance Painting Programs.

## 2. Description and Definitions

### 2.1 DESCRIPTION

**2.1.1** This document contains discussions of the risks associated with overcoating, methods of assessing risk, and means by which risks may be managed and reduced.

**2.1.2** Overcoating is generally defined as the practice of painting over an existing coating as a means of extending its useful service life. Overcoating may be a cost-effective alternative to complete coating removal and repainting. When the old coating contains lead, cadmium, or chromium, overcoating may be a particularly attractive option due to economic considerations. Overcoating presents certain risks as well (see risk definition below).

### 2.2 DEFINITIONS

For the purposes of this document, the following definitions will be used:

**Coating stress:** The tension that a coating has, which is capable of being imparted to the steel substrate or other coating.

**Embrittled coating:** Coating that has degraded to a friable condition but still has enough elasticity to adhere to the substrate or existing coating.

**Flaking:** The detachment of small pieces of the coating film, usually preceded by cracking, checking or blistering.

**Loose coating:** Coating that has delaminated and disbonded from the substrate or other coats, but has not fallen off.

**Marginally adherent coating:** A coating that exhibits tape adhesion of 2A or less (per ASTM D 3359), such that the overcoating risk is moderate or high.

**Overcoating:** Application of coating materials over an existing coating in order to extend its service life, including use of the appropriate cleaning methods. The procedure includes preparation of rusted or degraded areas, feathering edges of existing paint, low-pressure water washing of the entire structure to remove contaminants, application of a full intermediate coat over repaired areas, and optional application of a full topcoat over the entire structure. Overcoating may be a cost effective alternative to complete coating removal and repainting. When the old coating contains lead, cadmium, or chromium, overcoating may be a particularly attractive option due to economic considerations. Overcoating presents certain risks as well.

**Repaint:** Complete removal of the existing coating system followed by application of a new coating system (including appropriate cleaning methods.)

**Risk:** As used herein, “risk” refers to the chance that the overcoated system (old paint plus newly applied overcoat) will either fail catastrophically (e.g., delamination of the system) or will not provide the desired period of protection (e.g., early rust back).

**Spot repair:** A procedure entailing surface cleaning of isolated corrosion or paint breakdown areas using appropriate cleaning methods, and subsequent coating of these areas.

**Zone painting:** A procedure entailing surface preparation using appropriate cleaning methods and painting of a defined area of a structure. Zone painting may involve (a) many spot repairs within a defined area or (b) removal of all coating in a defined area, followed by application of a new coating system to that area.

Provided by : www.spic.ir Licensee: NISOC Library

## 3. Discussion

### 3.1 RISKS ASSOCIATED WITH OVERCOATING

**3.1.1 Delamination:** A primary risk associated with overcoating is that the overcoating system could cause delamination. If a delamination failure occurs, the overcoating investment is lost. Delamination is difficult to predict; however, an understanding of the underlying principles will help the coatings engineer reduce the chance of a delamination failure.

Delamination is primarily the result of internal stresses in the overcoat material being transferred to underlying or existing coating layers. Internal stress occurs as the applied paint shrinks. Several factors affect the degree of internal stress in the overcoat material, including the type of coating, the formulation, the film-forming conditions, the temperature and the coating's age and thickness. A good example of an increased internal stress is the oxidative curing of alkyds. Temperature fluctuations may also affect the level of internal stress. Brittle coatings are more apt to crack during temperature changes. The application of an overcoat may also affect the internal stress of the existing coating because the stress present in the overcoat is transmitted to the existing coating.

The internal stress of the overcoat is counteracted by its adhesion to the existing coating. A loss of adhesion of the existing paint system at either the steel/coating interface or within the layers of the existing coating may result in cracking of the overcoat.

Good overcoating systems should be designed so that there is higher tensile strength and rigidity in the existing or original coating than in the overcoat.

**3.1.2 Early Rust Back or Poor Coating Performance:** Another primary risk involved in overcoating is that the system will not provide an adequate period of service. The overcoat may not experience a catastrophic failure, such as delamination, but nonetheless may fail prematurely because of the severity of the service environment. This type of degradation may be manifested by pinpoint rust, undercutting at small breaks in the coating system, or blistering. The amount and type of surface preparation used prior to applying the overcoat can also affect the degree of protection afforded by the overcoat material.

### 3.2 FACTORS AFFECTING RISK IN OVERCOATING

**3.2.1 Influential Factors:** The risk of delamination or other coating failure described in 3.1 is influenced by the condition of the existing coating, substrate factors, compatibility of new and old system, the type of structure and the exposure environment, etc.

#### 3.2.2 Condition of Existing Coating

**3.2.2.1 Existing Conditions:** Visual and physical inspections, patch testing, and previous experience with similar systems for the expected exposure and conditions are proven tools in assessing the risk.

**3.2.2.2 Existing Coating System Type (Oil, Alkyd, Vinyl, Epoxy, Urethane):** It is important to be able to determine if multiple coating system types exist on the structure and to identify them in order to determine basic chemical composition, so that the proper overcoat system can be selected and special hazardous conditions can be identified.

**3.2.2.3 Thickness:** Thicker, aged coatings tend to be more highly stressed. Strong peeling forces can be generated during curing and aging of the overcoat. When overcoated, thicker, more highly stressed coatings are more likely to delaminate than thinner coatings with lower internal stress. Delamination may also be caused by thermal cycling that may disrupt the integrity of thick, aged coatings that have been overcoated. Rapid thermal cycling may accelerate system deterioration. Thicker, more highly stressed coatings are also more likely to sustain damage from blast media or other mechanical processes. This often results in a subsequent loss of adhesion that may affect the performance of the overcoat system.

**3.2.2.4 Number of Coating Layers:** Many layers of paint increase the chance of poor intercoat adhesion and may lead to delamination.

**3.2.2.5 Coating Age:** Depending on the curing mechanism, certain coatings tend to embrittle more with age than others. Alkyds are particularly susceptible to embrittlement with age.

**3.2.2.6 Chalking and Erosion:** Epoxy and alkyd coatings may chalk and erode with prolonged exposure. Generally this does not present a problem for overcoating as long as the loose chalk is removed prior to painting. Even severely eroded coatings with exposed primer may be good candidates for overcoating, provided the remaining coating has good adhesion and rusting is nominal.

**3.2.2.7 Delaminated Paint Films:** Paint films that exhibit delamination or other undesirable characteristics, such as cracking, are not good candidates for overcoating.

**3.2.2.8 Coating Brittleness:** Embrittled coatings tend to crack, providing sites for stress-induced peeling.

**3.2.2.9 Coating Adhesion:** The adhesion of the existing coating to itself and to the substrate is a critical factor.

Provided by : www.spic.ir Licensee: NISOC Library

However, it is difficult to precisely define a satisfactory adhesion value. At present, adhesion is generally evaluated by either ASTM D 3359 or ASTM D 4541. Systems exhibiting low adhesion values in these tests are more likely to delaminate when overcoated than are aged coatings with higher adhesion values. Generally, the aged coating system will fail at its weakest point. Coating type, age, thickness, and surface preparation all affect the adhesion of the aged coating system.

**3.2.2 Substrate Factors and Corrosion Pattern:** The condition and type of the substrate under the existing coating system must be determined. Mill scale, because it is smooth and slick, generally presents the weakest point of adhesion of the coating, even if the mill scale itself is tightly adherent to the steel. Filiform rust or undercutting could continue beneath the film unless the source is removed. The condition of the substrate may affect the performance of the overcoat system. Generally, the more corrosion present, the higher the degree of surface preparation required. This may cause localized problems on structures that were not cleaned uniformly prior to receiving the original coating. Localized rusted areas may dictate a different strategy than would spot rust over the entire surface area. There is a point at which it may no longer be cost-effective to overcoat.

**3.2.3.1 Surface Preparation:** The performance of the system is influenced by surface preparation prior to initial coating application. A surface that was previously blast cleaned is more likely to have satisfactory adhesion values, and is generally a better overcoat candidate, than a surface with existing mill scale.

**3.2.3.2 Surface Contaminants:** Surface contaminants, such as chloride and sulfates, can lead to decreased coating life and vastly accelerated corrosion, while grease and oil can result in poor wetting and adhesion of the overcoating system. Coatings differ widely in their ability to protect under these conditions. The problems associated with surface contaminants are not necessarily specific to overcoating; however, contaminants are less likely to be removed during overcoating because typically much less surface preparation is done. Less surface preparation holds down costs and reduces environmental and worker exposures to hazardous dusts. Extensive surface preparation is also more likely to cause mechanical damage to an old, marginally adherent, embrittled coating that may later delaminate.

**3.2.3.3. Pitting:** Pits often contain active corrosion cells (due to chlorides or sulfates) which can cause early failure of overcoat materials.

**3.2.4 Coating Compatibility:** Patch testing is a good method of determining whether the new coating is compatible with the existing one. The test should be performed so that the worst-case exposure to the patch is achieved. A method for patch testing is described in SSPC-PA Guide 5 and ASTM D 5064. (See Appendix A.1.2 for an example utilizing a test patch.)

**3.2.5 Type of Structure**

**3.2.5.1 Configuration of Surfaces:** Wide planar areas may delaminate first, particularly if the coating is applied over mill scale.

**3.2.5.2 Flexing:** The rigidity of the coated surface affects how the internal stresses in the coating are translated to interfaces. Flexible beams and wide planar areas tend to contribute more stress to a coating system than more angular, smaller planar areas.

**3.2.6 Exposure Environment:** The coating selected must be able to withstand the environmental conditions to which it will be exposed, as well as the surface conditions over which it is applied. Rapid thermal cycles tend to stress aged coatings, causing delamination at the weaker interfaces.

**3.3 APPLICATION, SERVICE AND COST CONSIDERATIONS:** The items below should be considered when determining whether overcoating is the most appropriate maintenance strategy for a particular situation.

**3.3.1 Application Considerations**

**3.3.1.1 Limitations on Surface Preparation Methods:** In some locations, because of noise or emission considerations, some methods of surface preparation cannot be used. As a result, complete removal and replacement of existing coating may not be an option. The preferred treatment would then be a limited surface preparation and overcoating.

**3.3.1.2 Limitations on Application Methods:** Some environmental or local restrictions prohibit certain application methods or coating products. It must be determined if the permissible application methods (e.g., brushing and rolling) are suitable for the overcoating product selected or considered.

**3.3.1.3 Overcoatability of the Coating:** Certain existing coatings can only be overcoated after major surface preparation such as scarifying the surface by sweep blasting or power tool cleaning. This situation may reduce or eliminate the economic and environmental advantages of the overcoat strategy.

**3.3.2 Service Considerations**

**3.3.2.1 Expected Remaining Service Life of the Structure:** The specifier should determine the remaining service

Provided by : www.spic.ir Licensee: NISOC Library

life (in years) of the structure. The cost of overcoating (including surface preparation, containment, materials, application, etc.), may not be justified for a structure to be replaced or decommissioned in a short time.

**3.3.2.2 Expected Life of the Overcoat System (in years):** The expected service life of the overcoat system is also a critical factor. Unfortunately there is a high degree of uncertainty in these projections. This uncertainty can be conveyed by assigning a range of years for the overcoating system lifetime (e.g., 4-12 years).

**3.3.2.3 Risk Threshold of Failure:** The specifier must recognize that there is some chance of a catastrophic or premature failure of an overcoat system. Overcoating may not be a viable option if the risk of a coating failure cannot be tolerated. While the decision to use an overcoating strategy is independent of the lead paint issue (lead may not be present), the presence of lead makes all the options more costly. If the overcoat causes a catastrophic failure, the environmental risks are significantly increased. There are various means to reduce the risk of a catastrophic failure. For example, total removal of a poor to marginally adhered existing coating, with new coatings subsequently applied, provides less risk than some overcoat strategies.

**3.3.3 Cost Considerations**

**3.3.3.1 Comparing Cost of Overcoating and Full Removal:** The specifier should estimate the cost of overcoating versus the cost of total removal of coating versus replacement of the steel. Assessment of these options, along with expected coating lifetimes and risks of failure, will aid in determining if overcoating is the most cost-effective option. If the overcoat option causes a catastrophic failure, not only is the cost of the investment lost, additional costs for repair and environmental cleanup could be incurred.

**3.3.3.2 Continued Presence of Lead:** Another important difference between overcoating and full removal is that full removal permanently eliminates the lead hazard. If the structure is coated with material that must be treated as a hazardous waste, such as a lead-based coating, a latent hazard will exist (whether or not an overcoating system is applied) until the lead-based coating is removed. In cases requiring elimination of potential hazards resulting from disturbance of lead-based coatings, overcoating is not a feasible maintenance strategy.

**3.3.3.3 Necessity of Structural Preservation:** The specifier should determine if the structure is still needed or whether demolition or abandonment is a possibility. This option will also entail costs; in particular, there would be a need to address worker handling of the lead coated structure components.

**3.3.3.4 Cost and Logistics of Structural Replacement:** Depending on where a structure is in its design life, it may be more cost-effective to replace the structure than to repaint or overcoat it. Factors such as usage, alternate traffic routes (for bridges), and the availability of alternate structures can affect this decision. The costs for demolition must also be taken into account.

**3.3.3.5 Urgency of Action:** The specifier should also determine if maintenance can be put off for a period of time.

**3.4 Assessing Risk in Overcoating:** The coatings engineer may assess the risk associated with overcoating by compiling historical data, performing visual and physical inspections, and by applying coating test patches.

**3.4.1 Coating History and Previous Overcoat Experience:** The designer should compile as much historical information on the aged coating, surface preparation, and structure as possible. Historic data is commonly available on types of coating, number of coating layers, coating thickness, surface preparation, periodic maintenance, and periodic inspections. It should be determined if lead or any other hazardous material is present in order to properly assess the risks. If other structures have been painted in a similar or identical manner and subsequently overcoated, this information may also be useful. Information specific to the structure's exposure environment such as the presence of acid precipitation, chemical splash or vapors, or windborne or de-icing salts, may also be useful.

If no historic records of coating types exist, ASTM D 5043 can be used to determine the types of coatings on the structure.

The original surface preparation and substrate condition may be determined by using a chemical paint stripper to remove the aged coating from a small area. Intact mill scale, underfilm corrosion, and blast profile can then be determined in this way.

**3.4.2 Visual Inspection:** A quantitative visual inspection of the aged coating system should be conducted to determine the extent of degradation including underfilm corrosion, chalking, peeling, flaking, cracking, checking, rusting, and blistering. Visible surface contaminants including mildew, debris, grease, and oil should be identified. Representative components or areas of the structure should be individually evaluated. ASTM D 5065 provides a detailed description of the visual inspection techniques that should be utilized.

**3.4.3 Physical Inspection:** A physical inspection of the structure and aged coating system should be conducted to determine the film thickness, number of layers of paint, adhesion, underlying substrate condition, coating type, and presence of soluble salt contamination. The number of test locations examined must be enough to provide a represen-

Provided by : www.spic.ir Licensee: NISOC Library

tative picture of all major conditions existing on the structure.

Table 1 in Appendix A.1 contains a simple algorithm for assessing the risk of overcoating based on film thickness and adhesion of the existing coating. Coatings are categorized by thickness in three ranges: 0 to <10 mils (0 to 254 micrometers), 10 to 20 mils (254 to 508 micrometers), and >20 mils (>508 micrometers). Adhesion is measured in accordance with ASTM D 3359 and film thickness by SSPC-PA 2. The algorithm works on the principle that the risk of failure increases with increasing film thickness and decreasing adhesion. Risk is categorized as OK (essentially no risk), LR (low risk), MR (moderate risk), HR (high risk), and NO (not a candidate for overcoating). See Appendix A, section A.1.1.

Alternatively, ASTM D 4541 can be used to assess the adhesion of the aged coating. In a survey of SSPC member paint manufacturers, minimum tolerable pull-off adhesion values of 50 to 300 psi (340 to 2040 kPa) were cited as necessary for overcoating. Lenhart and El-Naggar have suggested the pull-off adhesion values of 100 to 200 psi (680 kPa to 1360 kPa) are marginal for overcoating and that adhesion of 250 to 600 psi (1700 to 4080 kPa) is acceptable for overcoating.

The thickness of the aged paint system may also be determined using ASTM D 4138. The method is convenient for assessing the number and thicknesses of individual coating layers.

Various methods have been used to determine the level of soluble salt contamination on steel structures including swabbing retrieval, retrieval by magnetic limpet cell, and retrieval by adhesive blister patch cell. The percent retrieval is dependent on the method of retrieval, degree of contamination, and the length of time the salt has been on the surface. Ionic concentration may be determined by measuring the conductivity of the extracted fluid, using ion selective electrodes, or by using proprietary indicator test strips for chloride (silver dichromate indicator) and sulfate (2,2'-bipyridine indicator).

**3.4.4 Conducting a Patch Test:** One or more patch tests should be performed to assess the risk of overcoating. Representative areas or components of the structure should be selected for testing. It is important that any test patch include the feathered edges of the existing paint at prepared rusted or degraded areas. Areas in poorer condition as well as areas that typify the overall condition of the aged coating should be selected for evaluation. The condition of areas to be evaluated should be characterized using the visual and physical methods described in Sections 3.4.2 and 3.4.3. Surface preparation methods and overcoating materials should be selected for evaluation. The selected overcoat materials should be applied to the prepared test areas, inspected after cure, and documented. The test patches should be inspected a second time after 6 to 12 months of exposure. The test exposure period should span at least one winter season. ASTM D 5064 and SSPC-Guide 9, Section 6.2.2, provide more detailed descriptions of patch testing. See Appendix A, Section. A.1.2, Method B for a procedure utilizing a patch test.

Interpretation of patch test results is rather straightforward. Delaminated test patches imply a very high risk. Intermediate levels of risk are indicated by poor or reduced levels of intercoat or substrate adhesion. Signs of early rusting or blistering may also indicate a high risk associated with overcoating. Other warning signs include wrinkling, mudcracking, lifting, and peeling.

**3.5 Mitigating Risk in Overcoating:** The methods described above in sections 3.4.1 through 3.4.4 are useful in assessing the degree of risk associated with overcoating. If the risks associated with overcoating are deemed acceptable to the owner, then specific actions can further mitigate the risks associated with the process. Surface preparation, coating selection, and inspection are key elements in reducing the risk associated with overcoating.

**3.5.1 Surface Preparation:** Surface preparation methods should be selected to minimize damage to the aged coating while providing a clean surface free of contaminants, corrosion, and poorly adherent coating. Sweep and brush-off blasting may disrupt the adhesion or fracture the aged coating, leading to failures of the overcoat system. Similarly, when spot or area cleaning using an abrasive method, care should be taken not to allow blast media to impinge on areas adjacent to the cleaning zone. The cleaning method indicated during patch testing should be specified.

**3.5.2 Coating Selection:** Coating materials with a high degree of internal stress should not be used for overcoating. Overcoat materials should have good penetration and wetting characteristics. They should have relatively low film thicknesses, good flexibility, and should not contain strong solvents. Some commercially available coatings have been specifically formulated for overcoating. Some products have been validated in use as overcoats and should be considered as candidates. Many types of products are sold for overcoating including acrylic latex, calcium sulfonate alkyd, epoxy, oil and oil modified alkyd, polyurethane, polyester, wax, petrolatum tape, urethane-latex, and epoxy-urethane coatings. The epoxy coatings are predominant in terms of the number of coatings available. Within this class there are thicker film epoxy mastics and the relatively low-build unpigmented penetrating epoxy sealers. Overcoating materials should also afford adequate corrosion protection in the intended service environment. The coating material indicated during patch testing should be specified.

**3.5.3 Surface Preparation and Coating Inspection:**

Provided by : www.spic.ir Licensee: NISOC Library

As with any painting job, a thorough inspection of the prepared and painted surfaces should be conducted. The removal of soluble salts and other surface contaminants should be verified, in compliance with contract documents or a mutually agreed-upon procedure. A maximum permissible level of soluble salt contamination should be specified. Special attention should be paid to wet film thickness application to ensure that the DFT is within the specified range. The adhesion of the overcoat system should be determined and compared to the values obtained from the patch tests.

**3.5.4 Risk Management:** Risk management involves determining which of the factors listed in Sections 3.2 and 3.3 apply to the maintenance situation in question, determining their relative importance, and balancing these factors with the considerations described in Section 3.4.

In many cases overcoating has been used inappropriately. Because of the potentially large initial cost savings associated with overcoating, when compared to containment and complete removal, the temptation to overcoat is high. The large initial cost difference between these maintenance options has meant that owners are more tolerant of the risks involved in overcoating. Owners should first properly assess the risks associated with overcoating. If overcoating risks are deemed acceptable, then the facility owner should take additional steps to mitigate the risk of overcoating.

## 4. Conclusion

When considering whether to overcoat, factors affecting the internal stresses of the original coating and the overcoat must be considered, as should alternatives to overcoating. The lowest risk is likely to be associated with the highest cost, due primarily to the surface preparation and containment required. The highest risk will probably be associated with lower cost options due to the lower surface preparation costs. The specifier is urged to consider preventive maintenance programs in which surfaces are painted when they first show signs of degradation. At this stage, little or no surface preparation is needed, the existing paint exhibits good adhesion and all risks are minimized.

## 5. Disclaimer

This technology report is for information purposes only. It is neither a standard nor a recommended practice. While every precaution is taken to ensure that all information furnished in SSPC reports is as accurate, complete, and useful as possible, SSPC cannot assume responsibility or incur any obligation resulting from the use of any materials, paints or methods described herein, or of the report itself.

## 6. References

**6.1 SSPC AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 1** | Shop, Field, and Maintenance Painting of Steel |
| **PA 2** | Measurement of Dry Paint Thickness with Magnetic Gages |
| **PA Guide 4** | Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems |
| **PA Guide 5** | Guide to Maintenance Painting Programs |
| **SP 1** | Solvent Cleaning |
| **SP 2** | Hand Tool Cleaning |
| **SP 3** | Power Tool Cleaning |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |
| **SP 11** | Power Tool Cleaning to Bare Metal |
| **SP 12/NACE No. 5** | Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultra-high-Pressure Water Jetting Prior to Recoating |
| **Guide 6** | Guide for Containing Debris Generated During Paint Removal Operations |
| **Guide 7** | Guide for the Disposal of Lead-Contaminated Surface Preparation Debris |

**6.2 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **D 522** | Test Methods for Mandrel Bend Test of Attached Organic Coatings |
| **D 610** | Method for Evaluating Degree of Rusting on Painted Steel Surfaces |
| **D 1654** | Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments |
| **D 2370** | Test Method for Tensile Properties of Organic Coatings |
| **D 3359** | Test Methods for Measuring Adhesion by Tape Test |
| **D 3960** | Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings |
| **D 4138** | Method for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive Means |
| **D 4541** | Method for Pull-Off Strength of Coatings Using Portable Adhesion-Testers |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| **D 4940** | Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives |
| **D 5043** | (canceled) Methods for Field Identification of Coatings |
| **D 5064** | Practice for Conducting a Patch Test to Assess Coating Compatibility |
| **D 5402** | Standard Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rub |
| **D 5065** | Practice for Assessing the Condition of Aged Coatings on Steel Surfaces |

### 6.3 OTHER PUBLICATIONS

AASHTO, Guide for Painting Steel Structures, 1994.

Appleman, B. R., "Overcoating Vs. Removing Lead Paint: A Comparative Analysis," Journal of Protective Coatings and Linings, Vol. 10, No. 11 (November, 1993), pps. 60-83.

Byrnes, Geoffrey, "Delamination by Design", Materials Performance, Volume 32, No. 2 (February, 1993), pps. 45-47.

Boocock, Simon K., "SSPC Research on Performance Testing of Abrasives and Salt Retrieval Techniques,"Journal of Protective Coatings and Linings, Vol. 11 No. 3 (March, 1993), pps. 28-44.

Combatting Adhesion Problems When Applying New Onto Existing Finish Coats of Paint, NACE Publication 6H194, (Houston: NACE International, 1994).

Effect of Surface Contaminants on Coating Life, (Pittsburgh: SSPC, 1991), SSPC Publication 91-07.

Flores, S., J. Simancas, and M. Morcillo, "Methods for Sampling and Analyzing Soluble Salts on Steel Surfaces: A Comparative Study," Journal of Protective Coatings and Linings, Vol. 11 No. 3 (March, 1993), pps. 76-83.

Hare, Clive H., "Adhesive and Cohesive Failure: Definitions and Fundamental Macro-Effects,"Journal of Protective Coatings and Linings, Vol. 12, No. 10 (October, 1995), pps. 102-104.

Kline, Eric, and William D. Corbett, "Beneficial Procrastination" Journal of Protective Coatings and Linings, Vol. 9 No. 3 (March, 1992), pps. 48-56.

Korobov, Yuly, and Linda Salem, "Stress Analysis as a Tool in Coatings Research," Materials Performance, Vol. 29, No. 4 (April, 1990), pps. 30-35.

Lenhart, Charles F., and Kareem S. El-Naggar, "Evaluating Lead-Based Paint for Overcoating," Journal of Protective Coatings and Linings, Vol. 12, No. 7 (July, 1995), pps. 91-112.

Sandler, Melvin H. and Sam Spring, "Chemical Cleaning," in SSPC Painting Manual, Volume 1, Good Painting Practice, 3rd ed.,1993, pps. 90-97.

Trimber, Kenneth A., Industrial Lead Paint Removal Handbook, Second Edition. (Pittsburgh, KTA-Tator, Inc.,1993), SSPC Publication 93-02.

Trimber, Kenneth A., and Thomas W. Neal, Jr., "New Procedure for Field Classification of Paint Condition," Journal of Protective Coatings and Linings, Vol. 4, No. 11 (November, 1987).

## A. APPENDICES

### A.1 METHODS FOR ASSESSING OVERCOATING RISK

**A.1.1 Method A: Assessing Risk Based on Adhesion and Thickness.** This method assesses the risk of failure from overcoating using a combination of adhesion and film thickness of the existing coating. The thickness is categorized as <10 mils (254 micrometers), 10-20 mils (254-508 micrometers), and >20 mils (508 micrometers). The degrees of adhesion are based on ASTM D 3359. The principle is that the risk of failure is greater for thicker films and lower adhesion. The data are organized into a matrix shown in Table 1. The risks are categorized as: OK = essentially no risk, LR = low risk, MR = moderate risk, HR = high risk, NO = integrity too poor to salvage. This method is intended primarily for oil and alkyd coatings. The method has not been independently verified, but is believed to represent good practice based on field experience.

See Section A.2.1 for an example of the use of this table.

**A.1.2 Method B: Assessing Risk of Overcoating Using a Patch Test and Other Parameters.** This method features a patch test to assess the compatibility of the new overcoat with the existing coating. This method is used when the specifier has identified one or more candidate systems (including surface preparation and coating material) which are to undergo field evaluation on a small area of the structure.

The following steps are typically followed:

1. Identify structures to be evaluated for the potential of overcoating.
2. Identify representative portions of the structure for locating patch tests.
3. Assess condition of existing coatings using one or more of the methods described previously (e.g., adhesion, film thickness, age, number of layers, coating type, physical condition, presence of contaminants).
4. Select method or methods of surface preparation.
5. Select overcoat material and method of application.
6. Conduct and document patch testing (e.g., based on ASTM D 5064 or SSPC-Guide 9, Section 6.2.2).
7. Assess condition of existing coating/overcoat system using similar techniques (adhesion, coating degradation, appearance).



Provided by : www.spic.ir Licensee: NISOC Library

## TABLE 1
## RISK OF SALVAGING EXISTING COATING BASED ON ADHESION/THICKNESS CHARACTERISTICS

| Adhesion Classification | | | Coating Thickness | | |
|---|---|---|---|---|---|
| ASTM D 3359 Method B (using 5 mm guide) | Percentage Removed | ASTM D 3359 Method A | < 10 mils (<254 μm) | 10-20 mils (254-508 μm) | >20 mils (>508 μm) |
| 5B | 0% | 5A | OK | OK | OK |
| 4B | 1% to 5% | 4A | OK | OK | OK |
| 3B | 6% to 15% | 3A | OK | OK | LR |
| 2B | 16% to 35% | 2A | LR | LR | MR |
| 1B | 36% to 65% | 1A | MR | HR | HR |
| 0B | >65% | 0A | NO | NO | NO |

OK = essentially no risk
LR = low risk
MR = moderate risk
HR = high risk
NO = integrity too poor to salvage

* Not recommended above 5 mils (127 μm) unless otherwise agreed upon between contracting parties.

8. Analyze results.
   - Determine which existing condition or conditions are appropriate for being overcoated.
   - Assign relative ratings to surface preparations and overcoat material.
   - Determine adequacy of test procedure and results.
9. Select maintenance painting strategy.
   - Decide on overcoating, full removal, or other option.
   - If overcoating is decided upon, determine surface preparation and material to use.

**A.2 PAINTING SCENARIOS:** The following two hypothetical examples outline how the decision to overcoat can be made. The first example describes the criteria for deciding whether or not to overcoat a simple bridge. The second example describes the decision-making process for a water tank overcoat, based on field evaluation of test patches.

It is assumed, in both cases, that overcoating the structure is economically feasible (i.e., the overcoating is significantly less expensive than removal of the existing lead paint coating). It is also assumed that the structures will not be demolished, decommissioned, or undergo a major structural rehabilitation for at least 10 years. In the bridge example, it is assumed that the structure cannot be taken out of service (i.e., that replacement is not a possibility at this point), and that preservation has been presumed.

**A.2.1 Bridge Painting Using Risk Table:** This example uses a simple bridge and presents the criteria for deciding whether or not to overcoat.

**1. Structural Factors:** Determine where the structure is in its life expectancy. Is any major rehabilitation, such as a deck repair or widening, scheduled to take place? Can the structure be taken out of service completely, or does overcoating have to be performed while maintaining traffic flow? Is the structure historically significant? Does the location of the structure affect the choice of removal method?

**2. Condition of Steel:** Determine the condition of the steel surface from both a coatings aspect and a structural aspect. Are there fatigue-prone areas that must be addressed? Has there been excessive section loss?

**3. Condition of Coating:** What is the adhesion rating of the existing coating? How much rust is present and how is it distributed (is it localized or spread over the entire structure?) What is the thickness of the existing coating?

**4. Environmental Factors:** Determine whether there are any special environmental considerations that should be addressed (e.g., proximity to sensitive water body or residences).

It is possible to develop a strategy based on the amount of rust and paint to be removed. This strategy is based on the cleaning of rusty areas to an SSPC-SP 6 and the removal of loose or non-adherent coatings. The strategy is keyed to the percentage of surface area that is rusted and degraded.

**0–1% Rust:** If the coating, based on its adhesion rating and thickness, has an OK risk based on the risk table (Table 1, Section A.1.1), overcoating will be most successful. This is a "paint when it doesn't need re-painting" situation, and should be the lowest-cost option with the least amount of risk. The use of a surface-tolerant coating with washing of the surfaces is very viable in such an instance.

If the rating is NO, this is not a likely candidate for overcoating or any coating. This is a possible "do nothing"

Provided by : www.spic.ir Licensee: NISOC Library

situation. Because the existing coating is providing excellent corrosion protection, although poorly adhered, there is no imminent danger of section loss except (possibly) in localized areas, and some type of spot or zone repair may be considered. The paint work needs to be deferred until a total removal is warranted or replacement of the structure is viable during a major rehabilitation.

If the risk rating is MR or LR, the decision-maker's attitude toward risk will enter into the scenario. Spot or zone painting is an option, but full overcoating has to be questioned.

**1-15% Rust:** The amount of surface preparation has just gone up, and so has the cost. If the adhesion and thickness ratings are OK, overcoating of this structure is an excellent alternative. A decision will have to be made as to the type of surface preparation needed, e.g., minimal scraping or blasting.

If the risk rating is NO, the paint job needs to be deferred until a total removal is done or replacement of the steel is viable under a rehabilitation.

If the risk rating is MR or LR, spot or zone painting may be less risky than a full overcoat, depending on rust distribution. The service life remaining has to be weighed against the cost of a total removal now or in the future.

**16+% Rust:** At this amount of surface preparation, the cost of spot or zone painting is approaching that of full removal of the existing paint. The AASHTO Bridge Painting Guide indicates that, whenever the surface preparation area exceeds 15 to 20 percent of the surface area, the economics are such that a total removal of the lead paint is the most viable option. Overcoating may not be as viable an alternative, depending on the type of surface preparation specified. The overcoating of a structure having such extensive corrosion should probably be limited to structures with less than 10 years of expected remaining service life. Otherwise, do nothing until a full removal or replacement is an option.

**A.2.2 Water Tank Painting Using Test Patch Method:** This example is of a potable water tank with a lead containing coating system, requiring repair of the coating system. The owner wishes to repaint the structure with minimal impact on the surrounding sensitive area. The owner has agreed to conduct a patch test to determine the viability of proposed overcoating systems. The following procedure has been utilized to determine a recommended course of action.

**1. Structure and Coating History**

A. The structure is a potable water tank (elevated).
B. The tank has been coated with a three-coat alkyd system using a lead-containing primer.
C. The tank was last painted 18 years ago.

**2. Evaluation of Existing Coating System**

A. The coating thickness of the existing coating was measured and determined to be between 9 and 12 mils (229 and 305 micrometers).
B. Adhesion testing was performed on representative areas of the structure, using ASTM D 4541. The tensile adhesion was determined to be satisfactory on the intact portion of the coating.
C. Chips were taken from the structure for analysis of the existing coating.
D. Analysis revealed that the generic type of the coating was oil-containing alkyd.
E. Analysis determined the presence of 11% lead by weight in the total film. No cadmium or chromium was detected.

**3. Selection of Maintenance Options**

**A. Overcoating Options.** In this example, the recommended coating was a two-coat waterborne acrylic, which was claimed to be compatible over existing alkyd paint and over tight rust and mill scale. A penetrating sealer to improve wetting and adhesion of the acrylic coating was also recommended. Three alternate precleaning methods were selected as follows:

- No precleaning
- Solvent cleaning per SSPC-SP 1
- Detergent cleaning per SSPC-SP 1

The visibly degraded and rusted areas would be cleaned by power tool cleaning according to SSPC-SP 3.

**B. Removal Option.** With this option, the entire surface would be cleaned to bare metal using SSPC-SP 11, "Power Tool Cleaning to Bare Metal". A two coat waterborne acrylic would then be applied over the power tool cleaned surface.

**C. Full Removal and Abrasive Blast Cleaning Option**. This option would require full containment and ventilation, and would cause major disruptions to the tank operation and the nearby area. This option was eliminated prior to the patch testing.

**4. Patch Testing**

A.Three areas representative of the coating and steel condition were selected for patch testing. The areas were approximately 2 x 3 ft (610 cm x 914 cm).

B.The patches were prepared using the methods identified above:

- No precleaning

Provided by : www.spic.ir Licensee: NISOC Library

- Solvent cleaning
- Detergent cleaning

C. The penetrating primer and the two-coat waterborne acrylic were applied by conventional spray application over the areas in B.

D. The patches were allowed to weather for approximately five months, running from October to March.

**5. Patch Test Evaluation**

A. Tensile adhesion tests (ASTM D 4541) were conducted on the patch test areas.

B. The adhesion increased from an average of 300 psi to 800 psi (2040 to 5440 kPa) compared to the testing before the application of the penetrating sealer. The adhesion of the surfaces cleaned by solvent cleaning and detergent cleaning were about equal (i.e., 300 psi [2040 kPa] in both cases) and were slightly greater than the area which received no cleaning (e.g., 200 psi [1360 kPa]).

C. There was no visible delamination or cracking of the existing coating.

**6. Decision**

On the basis of the above information, the owner decided on the following system:

- Detergent cleaning of the entire surface
- Power tool cleaning (SSPC-SP 3) of the visibly degraded or peeling coating and the rusted areas.
- Penetrating sealer over the entire surface.
- Two coats of waterborne acrylic over the entire surface.

Provided by : www.spic.ir Licensee: NISOC Library

## INSPECTION OF COATING SYSTEM TO ASSESS RISK OF OVERCOATING

Inspector: _____ Date: _____

Structure: _____

Describe Overall Environment: _____ Hazardous Coating Present?(circle one): Yes No

### ASSESSMENT OF STRUCTURE

| Structure Component | Describe Local Environment | Rust SSPC-VIS 2 | Underfilm Corrosion ASTM D 1654 | Peeling | Blistering ASTM D 714 | Cracking/-Checking ASTM D 660/ D 661 | Chalking ASTM D 4214 | Film Thickness SSPC-PA 2 or ASTM D 4138 | Adhesion ASTM D 3359 or ASTM D 4541 | Level of Salt Contamination (List Method Used) | Condition of Underlying Substrate |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |



Provided by : www.spic.ir Licensee: NISOC Library

## COATING HISTORY

| | Original Coating System | First Maintenance Coating System | Second Maintenance Coating System |
|---|---|---|---|
| Surface Preparation | | | |
| Year Applied | | | |
| Primer | | | |
| Midcoat | | | |
| Topcoat | | | |



Indicate how coating systems were identified:

- ❑ Historic Records
- ❑ ASTM D 5043
- ❑ Other (describe) _____

Risk Assessment (use Table 1 of SSPC-TU 3, Technology Update on Overcoating)

- ❑ Essentially no risk
- ❑ Low Risk
- ❑ Moderate Risk
- ❑ High Risk
- ❑ Integrity Too Poor To Salvage

Remarks:

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# TECHNOLOGY UPDATE NO. 4

## Field Methods for Retrieval and Analysis of Soluble Salts on Substrates

## 1. Scope

**1.1** This Technology Update describes the most commonly used field methods for the retrieval and analysis of soluble salts on substrates.

## 2. Description and Use

**2.1** Coatings applied on surfaces contaminated with soluble salts over a certain concentration exhibit diminished performance. This Technology Update is intended to assist in retrieving soluble salts from a substrate and determining their concentration. This information will aid in deciding whether additional cleaning is required before the substrate can be coated. Section 3 of the Technology Update discusses the various methods for retrieving salts from a surface. Section 4 discusses the analytical methods used to determine the concentration of the soluble salts on the substrate.

## 3. Retrieval Methods

### 3.1 CLASSES OF RETRIEVAL METHODS

**3.1.1** Salt retrieval methods employed to help determine surface concentrations of salt on ferrous metals fall into three general classes:

**A. Cell Retrieval Methods.** A Bresle™ cell is a small adhesive patch which attaches to the structure forming a cell cavity. This cell is stuck onto the surface being checked by its self-contained adhesive edges. Distilled water is then injected into its center with a hypodermic needle. The patch fills up like a large paint blister. The liquid is then retrieved from the patch and tested for concentration of salts.

**B. Swabbing or Washing Methods.** A low conductivity fluid such as deionized water is used to extract salts from a steel surface. The method requires that the operator wear surgical latex rubber gloves to prevent cross contamination of the surface or the retrieved sample by salts naturally present on the surface of the skin.

**C. "Total" Extraction Methods.** The total extraction method involves the use of boiling deionized water to extract salts from a steel sample. This method is intended to be used to determine salt levels on steel in a laboratory setting. It may be used as a reference method to derive retrieval rates for the cell and swabbing methods described above. It may also be used for field samples cut from a sample or test panels exposed in a field or lot.

The first two methods can be used to help characterize surfaces encountered in either laboratory or field settings. In general, "total" extraction methods are only useful under laboratory conditions. No field method is believed capable of retrieving all the soluble salt from a surface. The proportion of salt retrieved by field methods depends on the method used, the roughness of the examined surface, the degree of rusting, and the ambient conditions. The presence of pits or deep craters on the surface can lead to grossly inaccurate measurement of salt contamination.

**3.2 REAGENT WATER:** All the retrieval procedures described in this document use deionized or distilled water as a retrieval fluid. The quality requirements for this reagent water are defined as follows:

The reagent water is distilled or deionized water with a specific conductance of about 1 μS/cm. Distilled water may be purchased at grocery stores. Alternatively, a portable demineralizer may be used to make deionized water on site. Pour tap water into the plastic bottle, attach the demineralizer cartridge in the direction indicated, invert, and squeeze out the desired amount of water (for many of the tests described below, at least 25 mL will be required). The cartridge can be used until the blue color turns brown, as indicated on the side of the cartridge. Once this occurs, replace the cartridge. Each cartridge should deionize approximately 3000 mL of water.

**3.3 ADHESIVELY BONDED CELL (BRESLE CELL):** The Bresle sampling procedure is described in detail in ISO 8502-6, "Bresle Sampling Method."

**3.3.1 Sample Acquisition Procedure**

1. Remove the backing (with Bresle logo) and the foam circle from the test cell and apply the cell firmly and tightly to a dry test surface, either vertical or horizontal.
2. Insert the 5 mL syringe needle into the cell through its spongy perimeter, taking care not to inject beneath the cell or into the semitransparent test area. Evacuate the air from the test area by pulling back on the plunger.
3. Inject 3 mL of distilled or deionized water into the cell taking care to keep air bubbles out of the

Provided by : www.spic.ir Licensee: NISOC Library

syringe. Hold the cell perimeter firmly during this operation to prevent water leakage.
4. Remove the syringe from the cell center (but not the spongy perimeter) and gently rub the top of the cell for 10 to 15 seconds to encourage dissolution of soluble salts.
5. Withdraw and reinject the water a minimum of three times, each time gently rubbing the top of the cell for 10 to 15 seconds. Then, remove as much of the water as possible and place it in a clean vial or other container.
6. If additional testing requires a higher volume of solution than that afforded by the extraction procedure, add deionized water to raise the sample volume up to the required level and note the new sample volume.
7. Use the water from step 6 to determine chloride ion concentration, ferrous ion concentration, or pH using one of the methods described in Section 4.
8. If additional samples are to be taken always use a fresh Bresle cell and clean syringe and needle; this will avoid cross contamination between samples.

**3.3.2 Advantages of the Bresle Cell Method:** The adhesively attached cells can conform to curved and irregular surfaces. Cells such as these are available in a variety of sizes; the most commonly used size retrieves salt from a surface of 12.5 $cm^2$. Smaller cell sizes permit assays of salt levels to be made at local corrosion sites such as craters or pits. The adhesively attached cells are commercially available.

**3.3.3 Limitations of the Bresle Cell Method:** The adhesively attached cells only accommodate a small amount of retrieval fluid. With the most commonly used cell size (12.5 $cm^2$ surface area), the actual quantity of cell fluid contacting the surface is a little over 3 mL. This can limit the range of analyses that can be performed to determine the surface salt levels. No in-line determination of conductivity can be performed with these cells. The Bresle cell will not adhere well to rusted surfaces, but it will adhere to clean or grit blasted surfaces so well there may be difficulty in removing the patch. The cell may leak through the hole introduced by the syringe.

**3.3.4 Retrieval Efficiency:** The efficiency of soluble salt retrieval is approximately 45% to 60% (see Appendix A).

**3.3.5 Alternative Test Cell:** A magnetically attached surface cell is described in Appendix B.

### 3.4 SWABBING OR WASHING METHOD

#### 3.4.1 Materials and Equipment for Swabbing Method

1. Reagent Water: as defined in section 3.2.1.
2. Cotton: Use cotton balls of the highest quality, sterile, absorbent cotton such as found in first-aid kits. (Note: chloride-free sponges of similar size may also be used.)
3. Gloves: Disposable vinyl or latex medical gloves must be worn to prevent contamination of the surface by salt found on the hands.
4. Two plastic beakers labeled A and B.
5. Graduated cylinder.

#### 3.4.2 Procedure for Swabbing Method

1. Use a ruler and marker to outline a representative surface area of specific size (e.g.,15 cm by 15 cm).
2. Using distilled or deionized water and a graduated cylinder, pour a measured volume (e.g., 22.5 mL) of pure water into beaker A. (Note: The suggested sample area and volume give a 1:10 ratio of volume to area. This can simplify later calculations of salt contamination levels.)
3. Repeat step 2 with beaker B.
4. Using a pair of tweezers or plastic gloves, dampen a cotton ball in the water in beaker A and thoroughly swab the area measured in step 1. After swabbing, swirl the cotton ball in the water and then squeeze it against the inside of beaker A to extract most of the water from the cotton ball.
5. Repeat this swabbing, swirling, and squeezing operation four times with fresh cotton balls and then leave the cotton balls in the water in beaker A.
6. Use a fresh cotton ball to dry the measured test area and place it in beaker A.
7. Stir the water and cotton balls for two minutes to achieve thorough mixing.
8. Record the final volume. (If low, bring up to 22.5 mL with distilled water.)
9. Place a number of fresh cotton balls identical to those used in steps 4 through 7 above into beaker B. Let sit, covered, for at least three minutes. This will provide the control sample.

**3.4.3 Retrieval Efficiency.** The efficiency of soluble salt retrieval is variable, ranging between 25% and 35% (see Appendix A).

**3.4.4 Advantages of Swabbing Method:** The most pronounced benefit of the swabbing retrieval method is that it provides an inexpensive and simple method for acquiring samples of salt from any steel surface. Retrievals can be conducted on a range of surfaces without regard to surface irregularities or condition.

A second benefit of swabbing methods is that they can be used on large areas, giving reliable indications of general surface contamination by salts. They also provide sufficient sample size for several analyses to be performed on the retrieved contaminants for both species and level.

Provided by : www.spic.ir Licensee: NISOC Library

**3.4.5 Limitations of Swabbing Method:** The major limitations of swabbing retrievals are:

1. Swabbing methods are difficult to perform in an overhead position. There is a distinct possibility that retrieved fluid is lost dripping from the swabs or running down the arms of the operator.
2. Swabbing methods have very low retrieval rates.
3. Swabbing is incapable of providing accurate levels of salt levels for small localized contamination such as that found in craters or pits.
4. There is a risk of contamination of a sample by the operator if the gloves become damaged. Check gloves for damage frequently. There is a risk of cross contamination from sample to sample if gloves are not cleaned between each sample.

**3.5 TOTAL EXTRACTION METHOD**

**3.5.1 Materials Required:** To perform a "total retrieval" using this laboratory reference procedure, the following items are required (all apparatus and sample containers should be previously cleaned with deionized or distilled water):

1. Hot plate, with thermostatic control.
2. Deionized water, conductivity no greater than 3 μS/cm.
3. Inert glass granules to prevent bumping of boiling water. (Note: the use of Boileezers is not suggested, as these contribute ions to the water and buffer the pH of the extraction fluid on the alkaline side.)
4. Steel panels of known dimensions (e.g., 10 x 15 x 0.64 cm [4 x 6 x 1/4 in]), previously cleaned to reflect the specification level of cleanliness used in the field, using the same abrasive as used in the field. If a level of cleanliness is not specified, then panels are cleaned to SSPC-SP 5 "White Metal Blast Cleaning" using metallic grit showing a conductivity rating less than or equal to 3 μS/cm when tested in accordance with ASTM D 4940.
5. Stainless steel or Pyrex pans of dimensions no less than 15 x 20 x 5 cm (6 x 8 x 2 in).
6. Test sections of interest of dimensions no greater than 13 x 18 x 2.5 cm (5 x 7 x 1 in).
7. 500 mL graduated cylinder.
8. Stainless steel tongs.
9. Conical funnel.
10. 750 mL laboratory storage bottle.

**3.5.2 Sample Acquisition Procedure**

1. The following items are placed in the pans:
   a. Approximately 350 mL of deionized water;
   b. Between 5 and 10 anti-bumping granules;
   c. A test section.
2. The pan is placed on the hot plate and raised to boiling temperature over a period no less than ten minutes. The assembly is maintained at boiling for one hour. The fluid level in the pan shall be maintained so as to completely submerse the test section. If fluid is lost by boiling or evaporation it shall be replenished during the test.
3. At the end of the test the hot plate is turned off. The pan is removed from the hot plate and the fluid is allowed to cool for at least one half hour.
4. The steel test section is removed from the pan and drained over the pan by holding with a pair of stainless steel tongs. When the panel has drained dry, the test section is removed from the work area.
5. The fluid in the pan is transferred to the graduated cylinder via the conical funnel. Sufficient deionized water is added to the graduated cylinder to bring the volume of material up to 500 mL.
6. The total fluid is thoroughly mixed by transferring between the storage bottle and the graduated cylinder.

**3.5.3 Retrieval Efficiency:** The efficiency of soluble salt retrieval is at least 90%.

**3.5.4 Advantages of Total Extraction Method:** This method provides a benchmark for determining the relative retrieval efficiency of cell and swabbing retrieval methods.

**3.5.5 Limitations of Total Extraction Method:** This method is unsuited for use in the field.

## 4. Analytical Methods

**4.1 QUANTITATIVE ANALYSIS:** The second part of this Technology Update discusses the most common analytical methods used to determine the amount of soluble salt contamination on a steel substrate. The following substances and quantities are described:

- Conductivity
- Soluble Chloride Ion
- Soluble Ferrous Ion
- Soluble Sulfate Ion

**4.1.1 Precision and Accuracy of Quantitative Measurements:** The precision of each quantitative analytical procedure is given in the section describing each method. Accuracy of each method is given when available.

**4.2 FIELD MEASUREMENT OF CONDUCTIVITY (TOTAL SOLUBLE SALTS):** This provides an accurate measurement of solution conductivity (± 1 μS/cm). From this conductivity measurement an estimate of the total soluble salts can be made.

First, determine the conductivity of the extract. Place the lower end of a calibrated pocket-sized conductivity

Provided by : www.spic.ir Licensee: NISOC Library

meter into the extracted water from Section 3.4.2, Step 8 or from Section 3.4.2, Step 6. This is Reading One. Record conductivity in μS/cm

Note: If a conductivity meter is used, transfer about 10 milliliters of the extracted solution into the cup of the conductivity meter. Select the appropriate range and record the conductivity reading in μS/cm. Convert to other units as described in Section 4.2.1.

Second, determine the conductivity of a control extract prepared as described in Section 3.4.2, Step 9. Place the lower end of a calibrated pocket-sized conductivity meter into the extracted water. Record conductivity in μS/cm). This is Reading Two.

Subtract Reading Two from Reading One. This is the corrected conductivity, Reading Three. This method is described in ISO 8502-9, "Field Method for Soluble Salt by Conductivity Measurement."

**4.2.1 Procedure for Estimating Total Soluble Salts:** The conversion of conductivity to total soluble salts only gives an approximate estimate of total soluble salts as sodium chloride. There is no way to determine the accuracy of such an approximation. To estimate total soluble salts, divide the conductivity (Reading One or Three from Section 4.2 above) by 4 (this treats all extracted matter as if it were sodium chloride). To convert ppm to $\mu g/cm^2$, multiply the ppm by the milliliters of water used for swabbing and divide by the area swabbed (in $cm^2$).

**4.3 FIELD DETECTION OF CHLORIDE ION BY KITAGAWA TUBE:** This method uses a vacuum sealed ampule containing a wick treated with a known amount of silver chromate solution (red/brown). On contact with chloride ions this converts to silver chloride (white), sweeping up the wick excess chromate ion. Water from the sample goes up the wick by capillary action. When the wick is fully occupied by sample fluid it accepts no more sample. Gradations on the side of the tube provide estimated levels of chloride ion directly in ppm. The determination range of the method is between 5 and 200 ppm. This method is described in ISO 8502-5, "Chloride Ion Detection Tube." The precision depends on the chloride level. In the range of 5 to 20 ppm, precision is ± 2 ppm. In the range of 20 to 60 ppm, precision is estimated at ±5 ppm. At higher levels, precision is estimated at ± 10 ppm.

**4.4 FIELD DETECTION OF CHLORIDE ION BY QUANTAB METHOD:** This method uses a color change principle similar to that of the Kitagawa Tube. To determine the chloride level, place the lower end of a Quantab test strip into the water. Allow the water to wick up and saturate the test strip, as indicated by the yellow band across the top of the strip turning blue (about 15 minutes). Then, record the scale number at the top edge of the white column (chloride ion causes the existing tan color on the strip to turn white) and compare it with the calibration chart enclosed with the Quantab bottle to determine the concentration of chloride ion in parts per million. The range of concentration over which this method is useful is from 30-180 ppm chloride ion. Precision is ± 5 ppm chloride.

Note: The reading from the strip must be converted to ppm chloride using the conversion chart supplied by the manufacturer from the same batch of Quantab strips. If a control reading was taken, repeat this procedure with the control fluid from Section 3.4.2, Step 9, and subtract the recorded value from that found for the surface extract to yield a corrected reading.

**4.5 FIELD DETECTION OF CHLORIDE ION BY TITRATION METHOD 1:** This method requires a commercially available test kit containing three reagents, syringe, graduated covered beakers, and instructions. Precision is ± 1 ppm. Test kits suited for this purpose are available from water quality testing supply houses such as Hach, Chemetrics or Cole-Parmer.

1. Put 5 mL of Reagent #3 into 500 mL of distilled or deionized water. Label as Solution #1.
2. Add 5 drops of Reagent #1 and 5 drops of Reagent #2 to 10 mL of surface extract sample.
3. Measure in Solution #1 at the rate of 0.1 mL per drop. Swirl each time, until the sample turns to a pale blue/purple color. Note amount measured into the sample; this is your titration volume (A) in 0.1 mL increments.
4. Compute concentration in ppm (mg/L) in 10 mL surface extract sample.

Extract Concentration (B - ppm) = Titration Volume (A).

5. Compute estimated area concentration ($\mu g/cm^2$):

$$C_A = \frac{(B * V_s)}{A_s}$$

where

$C_A$ = area concentration in $\mu g/cm^2$

B = extraction concentration in ppm (mg/L)

$V_s$ = total sample volume in mL

$A_s$ = area sampled in $cm^2$

**4.6 FIELD DETECTION OF CHLORIDE ION BY TITRATION METHOD 2:** This method uses commercially available vacuum sealed ampule titrators. Each vacuum sealed ampule contains the equivalent of Reagent 1 from Titration Method 1. The test solution is treated with small quantities of the reagents equal to #3 and #2 from Titration Method 1.

In a custom ampule holder the tip of the ampule is broken while the ampule neck is immersed in the fluid extracted from the surface. The ampule holder also acts as a trigger to begin and end small additions of the sample fluid to the ampule contents. The ampule neck must be kept under the surface of the water throughout the sample addition.



Provided by : www.spic.ir Licensee: NISOC Library

Small additions of sample to the ampule are done in this controlled manner until a characteristic color change is noted. Because the reagents are being added to each other in reverse order this color change is from purple/blue to yellow - the reverse of the color change seen in Titration Method 1.

This field titration method uses at most 5 milliliters of sample. Two ranges of sensitivity are available in field titration kits: 2-20 ppm chloride and 20-200 ppm chloride. Readings of ppm chloride are made directly from gradations on the side of the vacuum ampules. Precision for 2 to 20 ppm ampules is ±1 ppm. Precision for 20 to 200 ppm ampules is ± 5 ppm.

**4.7 LABORATORY REFERENCE METHOD FOR DETECTION OF CHLORIDE ION BY TITRATION:** ISO 8502-2, "Laboratory Determination of Chloride on Cleaned Surfaces" describes a classical silver chloride/silver nitrate titration to accurately measure chloride levels with a precision of ± 0.1 ppm chloride ion.

**4.8 QUALITATIVE FIELD DETECTION OF FERROUS ION:** The ISO 8502-1 method for field detection of ferrous ion uses a blotting paper treated with potassium ferricyanide solution. This is moistened and placed in contact with an abrasive blast cleaned surface. On contact with ferrous ions the paper shows blue spots. The sensitivity of the method is <1 ppm ferrous ion. No precision information is available, as this is a qualitative test.

**4.9 QUANTITATIVE FIELD DETECTION OF FERROUS ION:** To determine the ferrous ion concentration in parts per million, moisten a ferrous ion test strip with the solution being tested and compare the resulting color to the color chart on the container label. A complex is formed between 1,10-phenanthroline and ferrous ion that has a vivid red color. This method is sensitive to very low concentrations of ferrous ion. Color changes are seen even at ferrous ion concentrations below 1 ppm. Typical concentration ranges for test strips are between 0.5 to 10 ppm ferrous ion. Test strips of this type are manufactured by E. Merck and distributed by major laboratory supply houses such as Cole-Parmer or Fisher Scientific.

**4.10 FIELD DETECTION OF SULFATE ION:** This method works on the principal that if sulfate is present in the solution, it becomes turbid (cloudy) when barium chloride is added. The simplest and cheapest unit for measuring the degree of turbidity in the field is the optical comparator. The barium chloride is available as powder or premeasured tablets. The tablets are more convenient to use but take a little longer to dissolve. Panes of plastic with a known degree of cloudiness are compared side by side with the sample prepared using the kit. The pane closest in cloudiness to that of the sample is taken as the sample sulfate level. The interval between each pane value has to be quite large, because the eye is not as discriminating as a well calibrated spectrophotometer in the laboratory. Also, because the eye is not sensitive to very low levels of turbidity, the minimum level of sulfate which can be detected by this method is around 20 ppm. The method has great ease of use if you are satisfied with sacrificing both precision and sensitivity. At the present time, the simple optical comparator is the recommended method for field checking, as it is accurate enough to warn a coating inspector when there is a potential problem. Precision with this method is ± 5 ppm.

Should one have occasion to suspect that sulfate ion is an important active contaminant, there are more sophisticated versions of the turbidity method which bring the spectrophotometer to the field. This allows true turbidity measurements to be made with a high degree of precision. Precision with this method is ≤ ±1 ppm.

One important point to make about the detection of sulfate is that it must be made after the detection of chloride using a fresh portion of sample. Reversing the order of use of the sample will contaminate it with barium chloride, thereby invalidating any reading made.

**4.11 GENERAL METHOD FOR ESTIMATING SURFACE CONCENTRATION OF SALTS:** A general equation is given in Appendix C that converts quantities of salt in solution to estimated quantities of salt on a test surface.

## 5. References

**5.1 INTERNATIONAL STANDARDS ORGANIZATION (ISO) REFERENCES:**

**ISO 8502-1** Field Tests for Iron II Salts on Abrasive Blast Cleaned Surfaces (Field Test for Soluble Iron Corrosion Products)
**ISO 8502-2** Laboratory Determination of Chloride on Cleaned Surfaces
**ISO 8502-5** Chloride Ion Detection Tube
**ISO 8502-6** Bresle Sampling Method
**ISO 8502-9** Field Method for Soluble Salt by Conductivity Measurement

## Appendix A. Performance Characteristics of Retrieval Methods

To assess the performance characteristics of different retrieval methods, samples of contaminated steel were subjected to the various extraction procedures. The proportion of extracted material was determined by comparing the values for conductivity and for individual retrieved ionic contaminant levels with either:

- The level of deliberate contamination on the steel, if known, or
- The level of "total" retrievable salts determined using the boiling extraction procedure, or
- Both measures of extraction coefficient, in the case of deliberately contaminated steel only.

Provided by : www.spic.ir Licensee: NISOC Library

Two types of steel samples were used in the evaluation of the performance of extraction methods:

1. Steel samples with known levels of deliberately placed salt contamination.
2. Corroded steel samples from field exposures.

Based on retrieval studies conducted by SSPC, the following performance characteristics are suggested for each extraction method:

1. SSPC Swabbing Method - 25 to 35% of all surface salts extracted.
2. Magnetic Cell Method - 45 to 60% of all surface salts extracted.
3. Bresle Method - 45 to 60% of all surface salts extracted.

For additional details on retrieval methods, see S. K. Boocock, "SSPC Research on Performance Testing of Abrasives and Salt Retrieval Techniques," Journal of Protective Coatings and Linings, Vol. 11, No. 3, (March 1994), pp. 28-44.

## Appendix B. Magnetically Attached Surface Cell

**B.1 DESCRIPTION:** The test cell is designed to obtain contamination samples and measure the level of soluble salt still remaining on steel surfaces after blast cleaning or tank cleaning. The test cell system consists of six key parts:

1. Machined plexiglas plastic cell plate.
2. Four adjustable magnets to hold cell on steel.
3. Gasket of soft rubber or silicone rubber seal to hold in cell fluids.
4. Conductivity meter to permit immediate reading of fluid conductivity.
5. Syringe to pump fluid into and out of cell, and to transfer this fluid to sample containers.
6. Tubing and fittings to connect syringe to cell.
7. Flat stainless steel test plate.

The magnetically adherent cells can be modified so that an in-line conductivity meter can be used to assess the degree of retrieval. Magnetically adherent cells generally provide access to a larger surface area and accommodate a larger volume of retrieval fluid.

The magnetically adherent cells cannot be used on curved or irregular surfaces, and frequently leak when used on blast cleaned surfaces. Because of the large surface area assayed, these cells do not give an accurate indication of spot contamination at local corrosion sites, craters, or pits.

**B.2 SAMPLE ACQUISITION PROCEDURE:** Note: When first using the cell, use the metal plate as the test surface to get used to using the cell.

1. Obtain a supply of distilled water equivalent in quality to that defined for swabbing methods. Check the quality of the water to make sure it does not have a conductivity over 0.1 or 0.2 μS/cm.
2. Attach the cell to the surface or test plate, taking care to seat the cell well against the surface. Cell seating and gasket seal can be adjusted by manipulating the position of the magnets. Leakage is taken as cause for a complete repeat of a test series.
3. Connect the syringe and plastic tubing to the lower inlet on the cell (bottom end of conductivity meter). Use care when connecting the plastic fittings to the metal fittings on the cell, as the plastic threads can easily be stripped.
4. Take the syringe and petcock off the plastic tubing. Pull the plunger out of the syringe and close the petcock. Using the squirt bottle filled with distilled water, fill the syringe to the 20 mL mark and reinsert the plunger. Point the syringe upward, open the petcock and eject the air in the syringe. Reconnect to the tubing.
5. Turn on the meter, using the switch located at the top. The meter should read 00.0. If the meter does not read 00.0, the cell may need flushing to remove old salt, or the meter batteries may be weak and must be replaced.
6. With the meter showing 00.0, start to slowly inject the distilled water into the cell with the syringe. When the distilled water first enters the cell the reading will be very low (2-4). It will take about 15 mL of water to fill the cell. Do not try to put in the whole 20 mL of solution. If the cell is overfilled, water will drip out of the upper outlet port.
7. Let the water remain in the cell about 30 seconds, then slowly suck the fluid out of the cell with the syringe. Note how much higher the reading is now. Empty the cell with the syringe. Now refill the cell with the syringe. The reading will be a little lower since the syringe still had some clean water in it.
8. Repeat the flushing process several more times using the same water over and over. On bare steel, the total time should be three minutes. Note: If the water is kept on the bare steel too long, iron goes into solution and confuses the readings. However, the readings from the test plate will reach equilibrium quickly, since it is coated and no corrosion is taking place.
9. Note the final conductivity, and discharge the solution. Now refill the syringe with 20 mL distilled water and flush out the cell again. Note how much lower the reading is now compared to the final reading after three minutes. A lower reading indicates a cleaner surface.

**B.3 ADJUSTMENT OF CELL MAGNETS:**

1. The cell's plate and magnets should be adjusted to get a good seal between the soft rubber gasket and

Provided by : www.spic.ir Licensee: NISOC Library

the steel surface being tested. A flat steel test plate should be used with the cell for readjusting the magnets if the cell starts leaking or if the gasket is changed. The magnets should not need to be adjusted once they are set for a new gasket. If the cell does not seal properly, first check that the rubber gasket is properly set in the machined groove on the cell plate. Note: the cell is not cut flat and the groove is deeper on the lower side of the cell (inlet side).

2. If you have trouble with the gasket jumping out of the groove on the upper side (shallow end) use a spot of super glue or rubber cement to tack the gasket to the shallow side of the groove. The cell groove was not cut flat in order to help the cell work better on flat surfaces. If the cell is used on a tank bottom you should have the upper side facing in the same direction that the tank's bottom slopes up in order to be able to get the air out during the filling of the cell.
3. If the magnets need to be adjusted, do the following:
   a. Place the cell with magnets attached on the steel test plate.
   b. Put the cell and plate on a table, and loosen the eight screws holding the magnets. Check that the magnets and pole pieces are sitting flat on the metal plate.
   c. Push down on the cell so as to evenly compress the rubber gasket slightly. While holding the cell in this position, re-tighten the adjusting screws. Be careful not to strip the threads in the plastic.

## Appendix C. Estimating Surface Salt Concentration

A sample of the fluid is assayed immediately to determine salt level. The surface "level" of retrieved salt is determined using the following equation:

**Equation 1. Level of Salt per Unit Area**

$$L = [(\lambda' - \lambda^{\circ})*V]/A$$

Where L = Surface level of salt ($\mu g/cm^2$)
Where $\lambda'$ = Salt measurement (ppm) in fluid retrieved from the test section (ppm = $\mu g/mL$ )
Where $\lambda^{\circ}$ = Salt measurement (ppm) in fluid retrieved from the control section
Where V = Total volume of solution ($cm^3$)
Where A = Total surface area on which retrieval was performed in $cm^2$

**Estimate of Surface Level of Salt**

In the case of a boiling retrieval on a 4" x 6" x 1/4" panel the total surface area exposed to the retrieval fluid would be approximately 344 $cm^2$, and the total volume of fluid is 500 mL, even though less fluid is used to assay for salts. Presuming that our test section gave a salt measurement of 10 ppm and our control sample a salt measurement of 1 ppm, then:

L = Surface level of salt ($\mu g/cm^2$)
$\lambda'$ = 10 ppm
$\lambda^{\circ}$ = 1 ppm
V = 500 mL @ 500 $cm^3$
A = 344 $cm^2$
L = [(10-1) * 500]/344 = 13.1 $\mu g/cm^2$

Provided by : www.spic.ir Licensee: NISOC Library

SSPC-TU 5
May 1, 1999
Editorial Changes September 1, 2000

## SSPC: The Society for Protective Coatings

# TECHNOLOGY UPDATE NO. 5

## Accelerated Testing of Industrial Protective Coatings

### 1. Scope

**1.1** This document describes only laboratory experiments. In an industrial setting protective coatings are used for a variety of reasons. Service environments for protective coatings may range from a mild atmospheric exposure condition to a severe chemical or immersion setting.

### 2. Introduction

**2.1 APPLICATION OF ACCELERATED TESTING:** The application of accelerated testing differs from user to user. Some typical users are described below. The length of exposure of a coating system in any given test depends on the expected durability of the system and on the severity of the testing environment.

**2.1.1 Formulators:** Formulators use accelerated testing as a method to screen and compare the behavior of test formulations. The general goal is to optimize the formulation through experimental design or the typical ladder series. Formulators often employ ladder series in which one or more components in the coating formulation is changed in a controlled fashion.

**2.1.2 Manufacturers:** Manufacturers use accelerated testing in the same manner as a formulator. In addition manufacturers use accelerated testing for drawing comparisons between different products, to follow the results of shifts in raw material supply, and to show conformance with the performance requirements of procurement specifications.

**2.1.3 End Users:** The desire of end-users is to use accelerated testing as a reliable means of predicting long-term performance, but the goal of predicting performance is not achievable at this time, and it may never be achievable. Currently most end-users therefore employ accelerated testing to rank relative performance of competitive products or to screen coating systems for inclusion on qualified products lists.

Coating manufacturers and specifiers frequently use test exposures of coating materials in an attempt to assess the service life of various candidate coating systems before recommending their use. Test exposures are recognized to be a relevant predictor of coating system performance but can take a very long time to complete. Short term accelerated testing is often used to help provide early indications of coating system performance.

Predicting actual performance of a coating system, based solely on short term testing, can be misleading. A typical short term test may not impose on a coating system the unique combination or frequency of stresses that lead to failure in actual use.

**2.2 INTENDED USE:** This document is addressed to users and specifiers of protective coatings in an industrial setting. It is intended to provide information on the state-of-the-art in the technology of short term, accelerated testing of coatings. This technology update begins with a discussion of the environment in which coating systems are expected to perform. The specifier may use this update to assist in interpreting the results of certain accelerated tests. A qualitative analysis of the attributes of typical test methods and their relevance to actual exposures is also provided.

### 3. Reference Standards

**3.1** The standards referenced in this technology update are listed in Sections 3.3, 3.4 and 3.5.

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

**3.3 SSPC AND JOINT STANDARDS:**

| | |
|---|---|
| **SP 11** | Power Tool Cleaning to Bare Metal |
| **SP 5/NACE No. 1** | White Metal Blast Cleaning |
| **SP 6/NACE No. 3** | Commercial Blast Cleaning |
| **SP 7/NACE No. 4** | Brush-Off Blast Cleaning |
| **SP 10/NACE No. 2** | Near-White Blast Cleaning |
| **SP 12/NACE No. 5** | Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating |

**3.4 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

Provided by : www.spic.ir Licensee: NISOC Library

**B 117** Practice for Operating Salt Spray (Fog) Apparatus
**B 287** Method of Acetic Acid-Salt Spray (Fog) Testing (discontinued 1988)
**C 868** Test Method for Chemical Resistance of Protective Linings
**D 609** Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products
**D 870** Practice for Testing Water Resistance of Coatings Using Water Immersion
**D 1654** Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
**D 2246** (Canceled) Test Method for Finishes on Primed Metallic Substrates for Humidity-Thermal Cycle Cracking
**D 2247** Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
**D 2933** (Canceled) Test Method for Corrosion Resistance of Coated Steel Specimens (Cyclic Method)
**D 4585** Practice for Testing Water Resistance of Coatings Using Controlled Condensation
**D 4587** Practice for Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water-Exposure Apparatus
**D 5894** Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
**G 8** Test Methods for Cathodic Disbonding of Pipeline Coatings
**G 23** (Canceled) Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials. [Replace with appropriate cycle of G 151 to G 155.]
**G 26** (Canceled) Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials [Replace with appropriate cycle of G 151 to G 155.]
**G 53** (Canceled) Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials [Replace with appropriate cycle of G 151 to G 155.]
**G 85** Practice for Modified Salt Spray (Fog) Testing
**G 87** Practice for Conducting Moist $SO_2$ Tests

**3.5 NACE INTERNATIONAL STANDARDS:**

**TM0174** Laboratory Methods for the Evaluation of Protective Coatings and Lining Materials in Immersion Service

## 4. Characteristics of the Service Environment

**4.1 TYPICAL SERVICE ENVIRONMENT DESCRIPTIONS:** The specifier should always remember that coating systems subjected to short term testing are applied, and are expected to provide protection, in a real environment. A wide range of service conditions or environments can be defined under which industrial maintenance protective coatings are expected to perform. A description of environmental zones is given in Appendix A. This is taken from Table 3 of Chapter 1, "How to Use SSPC Specifications and Guides," in the SSPC Painting Manual, Vol. 2 Systems and Specifications. Many service environments under which a coating system shall perform are described by the classification system. To be of value, short-term accelerated tests should reproduce and accentuate the stresses imposed on a coating system by the actual service environment. There are some special use categories which are not covered in the environmental zone concept; these include abrasion resistance, marine fouling, graffiti control, mildew resistance, skidding, or high temperature service. Specially designed tests may be needed for such exposures.

**4.2 VARIABILITY OF THE SERVICE ENVIRONMENT:** With the sole exception of Zone 0 - Dry Interior (Appendix A), none of the environmental zones present a uniform, invariable service environment. All the service environments in Appendix A for which painting is recommended show variations in one or more of the following stresses:

- Temperature - e.g., daily changes, or freezing and thawing
- Humidity - e.g., morning formation of dew
- Time-of-wetness - e.g., periodic immersion, or rainfall
- Ultraviolet light intensity and exposure time
- Atmospheric pollutants - e.g., $SO_2/NO_2$, smog, salt or particulate deposition
- Chemical attack - e.g., exposure to deicing salts, splash and spillage of acids or alkaline agents
- Mechanical Stresses - e.g., chipping by stones, freeze/thaw cycling.

Natural service environments are as changeable as the weather. To help better replicate the type and frequency of coating failure found in actual use, many accelerated test methods incorporate controlled variations in test conditions.

**4.3 DESIRED OUTCOME OF EXPERIMENT:** The purpose of the program dictates the scale and nature of tests used to establish the performance of coatings. For example, a coating to be used in submersion would not be tested in the desert sun. Defining the intended service is important in determining the type of test to use in coating

Provided by : www.spic.ir Licensee: NISOC Library

evaluation. This entire process is known as experimental design.

## 5. Experimental Design Parameters

**5.1** Although the experimental design follows from the desired outcome, there are a wide variety of options available for consideration. The primary intent of experimental design is to reduce the number of independent variables which might affect and skew the results of the test program.

**5.2 VARIABLES CONTROLLED BY EXPERIMENTAL DESIGN**

**5.2.1 Choice of Substrate:** This should be identical with the substrate upon which the coating shall be applied; i.e., if the structure is ASTM A 36 steel, use A 36 steel panels for testing. On certain occasions, special panels may be required that mimic common structural shapes or commonly encountered design or fabrication flaws.

**5.2.2 Choice of Surface Preparation:** Unless surface preparation is a variable under study in the experiment, the type of preparation should be identical with the type of preparation required for real application. Typical specifications for surface preparation for industrial maintenance coatings are given by SSPC-SP 5/NACE No. 1, SSPC-SP 6/NACE No. 2, SSPC-SP 7/NACE No.4, SSPC-SP 10/NACE No. 3, SSPC-SP 11, and SSPC-SP 12/NACE No 5. Typical preparation requirements for sheet metal products are given in ASTM D 609.

**5.2.3 Profile:** This should be the profile recommended for use with the coating system unless it is a parameter to be examined in the test program.

**5.2.4 Choice of Coating Systems:** A valid control coating system or set of controls should be employed. Controls are those systems for which well-defined performance expectations are known, both in actual use and preferably within the tests used in the program. Control coating systems spanning a range of performance from poor-moderate through excellent should be used. This will help in subsequent ranking of candidate coating performance.

**5.2.5 Application:** This should be the type of application to be employed in actual use and that recommended by the paint manufacturer. Results obtained from use of ideal application methods, producing a defect-free film, will be of less use in assessing how a coating will perform in actual service.

**5.2.6 Types of Experimental Design:** If each factor in the design is given equal weight, then the design is called full factorial. Full factorial designs can dramatically increase the number of replicate specimens prepared. One can reduce the scope of the experimental design by careful selection of the points within a design at which maximum replication will occur. Such an approach is called a composite or mixture design. When screening coating formulations, a third approach is often taken which provides replication on only one point.

**5.2.7 Number of Test Replicates:** Replicate specimens are essential. The number of test replicates is governed in part by the type of experimental design. There are a number of operator dependent variations in applied system characteristics. To accommodate these uncontrollable variations, multiple specimens are needed for each factor in the experimental design. With very large replicate sets, 20 or more, it can be demonstrated that failures do not all occur at the same time. Dubbed lifetime analysis, this also reflects actual paint performance where failures on a large coated surface occur in a sporadic manner. For many comparative studies, a minimum of five to six replicates is appropriate to improve the validity of the data. (Almost all existing performance based specifications call for no more than two replicates.)

## 6. Characteristics of Controlled Accelerated Tests

**6.1 CLASSIFICATION OF ACCELERATED TEST METHODS:** Accelerated test methods can be classified in accordance with the following criteria:

1. Constant stress or cyclic/variable test
2. Industry standard test or non-standardized test
3. Multi-component stresses or single component stress

Appendix B summarizes the characteristics of many accelerated test methods typically used in evaluating industrial maintenance coatings.

**6.2 COMMON ACCELERATED TEST METHODS:** An ideal accelerated test would expose new coatings to the stresses expected in real exposure, would induce exactly the type of failures observed in real use, and would do so quickly. In reality, this ideal is difficult to achieve.

**6.2.1 Salt Spray Testing (ASTM B 117, ASTM B 287):** Salt spray testing in accordance with ASTM B 117 and ASTM B 287 exposes panels to constant stresses of temperature (95°F), humidity (100%) and a corrosive salt solution (for ASTM B 117 testing, 5% NaCl is used). Panels are commonly scribed and evaluated for rust, blister, and scribe undercut failure. Typical test durations can run anywhere from 500 hours to 5,000 hours or more. Originally devel-

Provided by : www.spic.ir Licensee: NISOC Library

oped for use in testing metallic coatings, ASTM B 117 testing became the method of choice for evaluation of coatings on metal products because of the lack of other suitable test methods.

Salt fog testing in accordance with ASTM B 117 is the most widely used method for screening coating performance. Many specifications include the use of this test. Modes of failure observed are blistering, rusting on the panel face, and scribe undercutting. The rust product created by this test is unlike that found in most atmospheric exposures. Blistering failure is far higher than found in most atmospheric exposures.

Studies have shown that the rankings of coatings in salt fog testing often bear little correlation to rankings from exposure in any real atmospheric service. In part this is because the failures are different. The type of reactions occurring on the sample panel are unique to the test chamber; this also causes the discrepancy in results between salt fog testing and real exposure. Table 1 depicts the correlation between salt fog exposures and some typical exposure sites. The data is taken from two studies, SSPC's Performance of Alternate Coatings in the Environment (PACE), and a study of the relative merits of constant or cyclic salt spray exposures by the Paint Research Association (PRA).[1, 2] The PACE results, Table 1A, show that, with one exception, for subclasses of the full set of coatings tested, poor or low correlation is observed between time to failures by rusting at the marine site, and preliminary screening in ASTM B 117 salt spray. The study at the PRA, Table 1B, used a lower number of coating samples, and also indicates poor correlation between exterior exposure and salt spray exposure. The poor correlation observed is quite typical; note that even the marine site results do not correlate well with ASTM B 117 exposures, especially when waterborne or lead-free coatings were examined.

In some coatings, the high concentration of salt present can induce saponification reactions that contribute to the observed undercutting and blistering failures. Coatings are being tested for their resistance to this unique test environment. Coatings may perform poorly in this test and yet provide good service in outdoor exposures. Despite this anomaly, ASTM B 117 testing continues to be specified and used.

**6.2.2 Cyclic Salt Spray Testing (ASTM G 85 Appendix A5):** Cyclic salt spray testing involves periodic drying of the panel surfaces following exposure to a salt fog. Unlike ASTM B 117, the salt used is a weak mixture of ammonium sulphate 0.325% and sodium chloride 0.05% and the salt fog exposure takes place under ambient conditions.[4] The

**Table 1A - CORRELATIONS OF TIME TO RUST FAILURES**
**ASTM B 117 Salt Fog vs. Kure Beach**

| Paint System | Number of Specimens Tested | Correlation Coefficient | Degree of Significance |
|---|---|---|---|
| All Systems | 56 | 0.53 | >99% |
| Lead and Chromate in Oil | 15 | 0.63 | <95% |
| Lead and Chromate, Oil-Free | 25 | 0.57 | <95% |
| TT-P-86G, Type II | 8 | 0.95 | >99% |
| Proprietary Pigment #10 in Oil | 6 | 0.334 | low |
| Acrylic | 6 | 0.308 | low |

Data taken from references 1 and 8 (SSPC).

**Table 1B - PRA TEST**
**Spearman Rank Correlations[1]**

| Comparison Made | Correlation Coefficient |
|---|---|
| Exterior vs. Salt Spray | 0.18 |
| Exterior vs. Cyclic Salt Spray | 0.68 |
| Salt Spray vs. Cyclic Salt Spray | 0.65 |

[1] Minimum correlation or 95% confidence requires a correlation coefficient of at least 0.87.
Data taken from reference 2 (PRA).

Provided by : www.spic.ir Licensee: NISOC Library

rapid drying of panels is accomplished by panel heaters and forced air coming into the cabinet. Panel heaters are present in the walls of the cabinet. During the dry cycle the panel heaters are turned on and the temperature in the cabinet rises to 35°C. Ratings and panel preparation are similar to that for ASTM B 117 testing.

This test is claimed to better reproduce macroscopic visual degradation typical of field failures such as rusting and scribe undercutting. It reduces the incidence of underfilm blistering noted in many other test methods. As blistering is little seen in most real exposures, the test is claimed to be more representative of actual coating performance.

The chemical make up of the rust product is believed to be closer to that found in real exposures. The rust is less crystalline in nature, i.e., more amorphous. The change in character of rust from the ASTM B 117 test is attributed to the constituents and concentrations of the electrolyte and the use of a cyclic exposure. Table 2A depicts the relative performance of a set of ten coatings in cyclic salt spray, salt spray testing in accordance with ASTM B 117, and normal industrial exposure. Accelerated tests were conducted for 1,500 hours and exterior exposures were conducted for 40 months.

The performance of the coating systems was assessed on the basis of undercutting at a deliberately placed scribe defect (see Figure 1 and Table 2B). Scribe undercutting was measured in units of 1 mm in accordance with ASTM D 1654. There are a number of clear discrepancies in the scribe undercutting recorded in the ASTM B 117 exposure when compared with real performance from the field exposure site. The incidence of anomalous poor performance is lower in the cyclic salt spray exposure. When the scribe values from the field data are plotted against those from the two accelerated tests, regression line fits can be derived between the two sets of data. These indicate the degree of correlation between the artificial test environment and the actual exposure. While the ASTM B 117 test has a lack of correlation with actual exposure, the cyclic salt spray test shows a strong positive correlation to performance at the industrial site, as shown in Figure 1.

The cyclic salt spray test described in ASTM G 85, Appendix 5 is used in combination with ASTM D 4587 exposure to create a multi-component exposure defined in ASTM D 5894 (see Section 6.2.3.1).

**6.2.3 Combination Cyclic Exposures:** An approach to producing a cyclic exposure entails combining exposure

**TABLE 2A**
**Scribe Data from Field and Lab**

| Paint System | Scribe Field[1] mm/40 months | Scribe Cyclic Salt Spray[2] mm/1500 Hours | Scribe ASTM B 117 Salt Spray[3] mm/1500 Hours |
|---|---|---|---|
| 1 | 14.0 | 16.0 | 4.0 |
| 2 | 3.5 | 2.0 | 0.0 |
| 3 | 2.0 | 12.3 | 32.0 |
| 4 | 3.0 | 8.3 | 18.7 |
| 5 | 3.0 | 7.5 | 8.0 |
| 6 | 2.0 | 4.3 | 4.0 |
| 7 | 1.0 | 2.0 | 2.0 |
| 8 | 0.0 | 0.0 | 0.0 |
| 9 | 3.5 | 5.8 | 3.3 |
| 10 | 3.5 | 6.4 | 8.8 |

[1] Reflects the average of four replicates.

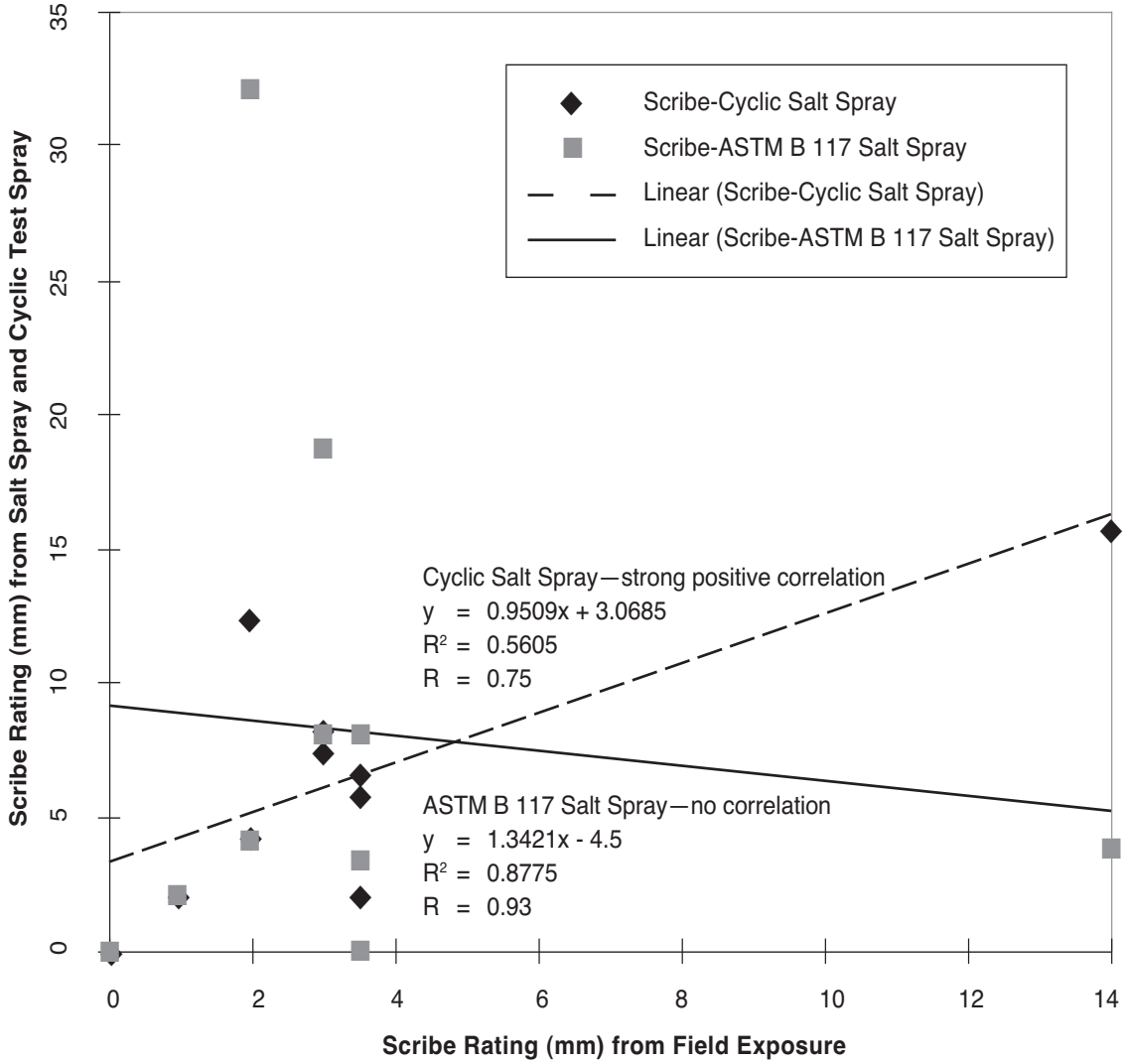
[2] Reflects the average of four replicates.

[3] Reflects the average of three replicates.

Data taken from SSPC internal research project on Advances in the Performance Evaluation of Coatings (APEC).

Provided by : www.spic.ir Licensee: NISOC Library

**FIGURE 1**
**Comparison of ASTM B 117 Salt Spray and Cyclic Salt Spray with Exterior Performance -- Industrial Site**




This figure reflects the data in Table 2A.

Exposure times were 40 months for the field exposure and 1,500 hours for the two accelerated exposures.

Scribe measurements are the maximum rusting or undercutting measured in mm from the center of the scribe at any point along the scribe.

Field and cyclic salt spray measurements reflect the average of 4 replicates; ASTM B 117 salt spray measurements reflect the average of 3 replicates.

within different cabinet environments. These combination experiments are similar to the humidity freeze-thaw cycling discussed later. They can be customized experiments with any desired degree of complexity deemed appropriate to mimic actual service.

**6.2.3.1 Combined Cyclic Salt Spray UV/Condensation (ASTM D 5894):** One recent example of a combination cycle experiment involves both a cyclic salt spray exposure (as defined in ASTM G 85, Appendix A5) and ultraviolet condensation apparatus exposure. Marked improvements in correlation with outdoor exposure are claimed for this experiment. The test developers stress that ultraviolet light exposure is critical to the success of the experiment. Polymer degradation is induced by the UV light, weakening the coating and making it more susceptible to undercutting and blister formation at the scribe. Table 3 and Figure 2 depict the results from this experiment. Again scribe undercutting measured in accordance with ASTM D 1654 is used as the measure of coating system performance. Results are shown for three coating systems exposed in five environments: two natural exposures and three accelerated tests. In addition to the combination cyclic salt spray with ultraviolet condensation, panels were exposed to the previously described cyclic salt spray test and salt spray testing in accordance with ASTM B 117. The exterior exposures

Provided by : www.spic.ir Licensee: NISOC Library

**Table 2B**
**Correlation of Scribe Results Between Field and Accelerated Tests**
**Spearman Correlation Matrix[1]**

| Exposure Environment | Field | Cyclic | ASTM B 117 |
|---|---|---|---|
| Field | 1.000 | --- | --- |
| Cyclic | 0.749 | 1.00 | --- |
| ASTM B 117 | -0.999 | 0.553 | 1.000 |

[1] Coefficient numbers in matrix cells reflect degree of regression fit between data sets.
Data taken from SSPC internal research project on Advances in the Performance Evaluation of Coatings (APEC).

**Table 3**
**Scribe Undercutting Rating for Three Systems in Five Exposures**

| Paint System | Wet/Dry Test[2] | UV/Wet/Dry Test[2] | Marine[3] | Industrial[3] | Salt Fog[2] |
|---|---|---|---|---|---|
| 1 | 7 | 6 | 5 | 10 | 7 |
| 2 | 7 | 9 | 7 | 10 | 7 |
| 3 | 7 | 4 | 0 | 8 | 8 |

[1] Scribe undercutting ratings are recorded in accordance with ASTM D 1654. 10 indicates no creepage at the scribe,0 indicates complete failure [16 mm (0.6 in) scribe creepage].
[2] 2,000 hours.
[3] 27 months.
Data taken from reference 5 (Simpson et al.)

consisted of an industrial site and a coastal marine site. Data is presented from ratings after 27 months exposure at the exterior test sites, and the accelerated tests were conducted for 2,000 hours.[5] NOTE: Durations of exposure for high performance coatings may be longer than those used in the referenced test program.

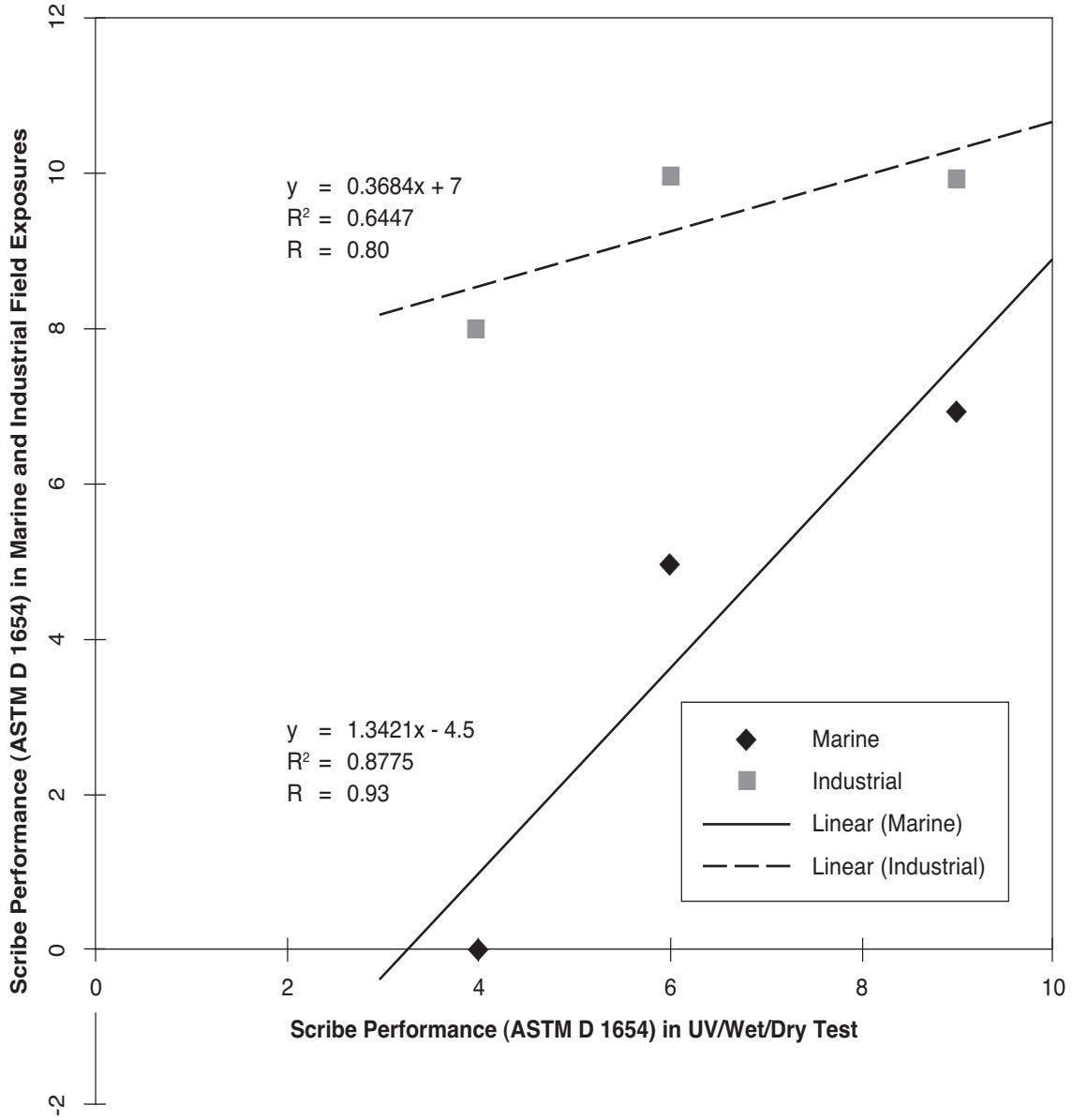
The data shown in Table 3 have been converted to a decimal scale in which a ten indicates no scribe undercutting and a zero indicates 16 mm creepage from the scribe; the scale is defined in ASTM D 1654. Simple examination of the data in Table 3 shows that only the combination cycle experiment, UV/Wet/Dry Test, exhibits a close relationship with the data from the marine exposure site. The relationship between the combination cycle experiment and both marine and industrial exposure is shown in Figure 2; the small data set contributes to the high degree of correlation.

Other early indicators of coating failure suggested by this test include loss of gloss and increase in coating surface roughness. The visual appearance of the blisters formed near the scribe is nearly identical with that of the samples exposed in an industrial environment. The relative ranking of four generic coatings was remarkably similar in both the test and actual exposures. (The use of ASTM D 5894 and the independent cyclic salt fog exposure component is only recommended for organic coatings, or coating systems in which inorganic zinc is topcoated with organic topcoats. Direct comparisons of the results of exposure of untopcoated inorganic zinc-rich primers with systems based on organic coatings, or with organic topcoats, are misleading.)

**6.3 OTHER STANDARD METHODS:** Tests other than ASTM B 117, ASTM D 5894, and ASTM G 85 are also used for testing of coatings intended for atmospheric or other service environments. From surveys which SSPC conducted for the Navy Civil Engineering Laboratory and The Federation of Societies for Coatings Technology, a list of these tests was produced. All the tests listed below are currently used, but less frequently than ASTM B 117 testing.[3]

Provided by : www.spic.ir Licensee: NISOC Library

**FIGURE 2**
**Performance Correlation of 27 Months Field Exposure Versus 2,000 Hours Cyclic Test**




This figure reflects the data in Table 3 (reference 5, Simpson et al.).
Scribe undercutting ratings are recorded in accordance with ASTM D 1654. 10 indicates no creepage at the scribe; 0 indicates complete failure [16 mm (0.6 in) scribe creepage].

- Humidity testing - ASTM D 2247, ASTM D 4585
- Light, Heat and Condensation Exposures - ASTM D 4587, ASTM G 53
- Artificial Weathering - ASTM G 23, ASTM G 26
- $SO_2$/Moisture Exposure - ASTM G 87
- Immersion Testing - ASTM C 868, ASTM D 870, NACE TM0174
- Cathodic Disbondment - ASTM G 8
- Humidity Freeze-Thaw Cycling - ASTM D 2246 (discontinued)

Humidity freeze-thaw cycling has been used in combination exposures that cycle panels between different exposure chambers. One example involved the ASTM D 2246 (discontinued) testing used in combination with ASTM B 117 and ASTM D 4587 exposures. With the exception of ASTM B 117 testing, this regimen is asserted to inflict upon a coating all the stresses expected in northern climates.

**6.4 CYCLIC/COMBINATION TESTS:** New cyclic/combination exposure apparatuses have been developed by the automotive industry which put panels through complex multi-step cycles with light, controlled humidity, humidity with condensation, and electrolyte exposure.

Provided by : www.spic.ir Licensee: NISOC Library

**6.4.1 Cyclic Immersion with Exposure to Light and Heat:** Recently, a cabinet test was submitted to ASTM for consideration which entails an immersion cycle in an electrolyte of the tester's choosing along with humidity and UV exposure. The method was devised to test performance of industrial maintenance coatings. This multi-component cyclic immersion test is currently being evaluated by both ASTM and SSPC.

**6.5 IMMERSION TESTING:** The procedures described in ASTM D 870 include either partial or full immersion in distilled or de-mineralized water at atmospheric pressure. The temperature and the duration of the test can vary. Ratings are based on blistering, color change, loss of adhesion, softening, or embrittlement.

**6.6 INFLUENCE OF COATING CHARACTERISTICS ON ACCELERATED TESTING:** The results from accelerated tests depend on the behavior of the coating film under the stresses imposed by the test protocol. This behavior is related to fundamental characteristics of the coating system. Length of exposure for any test method discussed in this document depends on the types of coatings being tested, the expected outcome of the experiment, and other experimental design factors. The lengths of exposure referenced in this document are not intended to indicate minimum or maximum duration of expsoure for any of the methods referenced in this document.

**6.6.1 Coating Thickness**

**6.6.1.1 Permeability:** In many accelerated corrosion tests the coating system is subjected to high humidity or direct contact with water. The permeability of the coating film will influence the degree to which water transports to the substrate. In general, a thicker film coating system will have slower transport of water to the substrate.

**6.6.1.2 Cracking Resistance:** Another example of system behavior influenced by film thickness is cracking resistance. Particularly in freeze-thaw exposures, overly thick films may show a greater tendency to crack.

**6.6.2 Pigmentation:** The type of pigmentation present in a coating film influences the behavior of that system in real exposures. This also holds true for the behavior of the coating system under certain accelerated tests, though the behavior exhibited may not be that found in nature. For instance, in salt fog exposure (ASTM B 117), an anti-corrosive pigment may rapidly deplete from a primer. Conversely, under the same exposure conditions, a zinc-rich inorganic primer will show high resistance to rusting. In part this is because the zinc metal pigment forms a reaction product with the salt that serves to seal pores in the coating.

By way of contrast, in cyclic salt fog exposure in accordance with ASTM G 85 - Appendix 5, untopcoated zinc-rich primers show surprisingly poor performance. The reaction product of the zinc in this experiment is soluble and washes from the surface. Thus, the zinc-rich primer never seals and will show early corrosion. This behavior is unlike that found in normal atmospheric performance. As a result, ASTM G 85 - Appendix 5 cyclic salt spray is not recommended for use in evaluating untopcoated zinc-rich primers.

**6.6.2.1 Barrier Pigments:** Barrier pigments can influence behavior in accelerated tests in several ways. Barrier pigments such as aluminum flake or micaceous iron oxide improve permeability resistance to water; they may also serve to improve chalking resistance. Flexibility and cracking resistance are also modified or enhanced in a coating material which incorporates barrier pigmentation.

**6.6.2.2 Color Pigments:** For a given proprietary product, different pigment blends may be used to achieve a particular color. As a result, different colors of the "same" coating may exhibit different performance characteristics (permeability, gloss and color retention, etc.) in accelerated tests.

**6.6.3 Resin Type:** The type of resin will play a role in coating system behavior in accelerated testing. Examples include high resistance to chalking by acrylics and urethanes when exposed to ultraviolet light, and saponification of alkyd resins in salt fog (ASTM B 117) exposure. Degree of permeability is also directly related to resin type and coating chemistry. For example, alkyds are more permeable than epoxies; and depending on formulation, one epoxy can be more permeable than another epoxy.

## 7. Disclaimer

This technology update is for information purposes only. It is neither a standard nor a recommended practice. While every precaution is taken to ensure that all information furnished in SSPC technology updates is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, paints, or methods specified herein, or of the technology update itself.

## 8. References

1. Performance of Alternate Coatings in the Environment, SSPC reports 89-03, 89-11, 89-12 (1989).
2. A. F. Sherwood, The Protection of Steel Work Against Atmospheric Pollution: Part II - Natural Weathering and Laboratory Tests, Paint Research Association Technical Report 8-87, December 1987.
3. B. R. Appleman, "Survey of Accelerated Test Methods for Anti-Corrosion Coating Performance," Jour-

Provided by : www.spic.ir Licensee: NISOC Library

nal of Coating Technology, 62, 787 (1990): p. 57.
4. F. D. Timmins, "Avoiding Paint Failures by Prohesion," Journal of the Oil and Colour Chemists Association, 62, 4 (1979): p. 131.
5. C. H. Simpson, C.J. Ray, B.S. Skerry, "Accelerated Corrosion Testing of Industrial Maintenance Paints Using a Cyclic Corrosion Weathering Method,"Journal of Protective Coatings and Linings, 8, 5 (1991): p. 28.
6. Performance Testing of Marine Coatings, SSPC report 90-02 (1990).
7. M. E. McKnight, J. D. Martin, "Quantitative Evaluation of Blistering and Corrosion in Organic Coating Systems," in New Concepts for Coating Protection of Steel Structures, ASTM STP-841 (1984), p. 13.
8. Advances in Accelerated Testing and Coating Characteristics, SSPC 91-15 (1991).

## APPENDIX A

## SSPC ENVIRONMENTAL ZONES

| | |
|---|---|
| 0 | Dry interiors where structural steel is imbedded in concrete, encased in masonry or protected by membrane or non-corrosive contact type fireproofing. |
| 1A | Interior, normally dry (or temporary protection). Very mild (oil base paints now last six years or more). |
| 1B | Exteriors, normally dry (includes most areas where oil base paints now last six years or more). |
| 2A | Frequently wet by fresh water. Involves condensation, splash, spray or frequent immersion. (Oil base paints now last five years or less.) |
| 2B | Frequently wet by salt water. Involves condensation, splash, spray or frequent immersion. (Oil base paints now last three years or less.) |
| 2C | Fresh water immersion |
| 2D | Salt water immersion |
| 3A | Chemical atmospheric exposure, acidic (pH 2.0 to 5.0) |
| 3B | Chemical atmospheric exposure, neutral (pH 5.0 to 10.0) |
| 3C | Chemical atmospheric exposure, alkaline (pH 10.0 to 12.0) |
| 3D | Chemical atmospheric exposure, presence of mild solvents. Intermittent contact with aliphatic hydrocarbons (mineral spirits, lower alcohols, glycols, etc.) |
| 3E | Chemical atmospheric exposure, severe. Includes oxidizing chemicals, strong solvents, extreme pH's or combinations of these with high temperatures. |

Provided by : www.spic.ir Licensee: NISOC Library

# APPENDIX B
## Characteristics of Common Accelerated Test Methods

| | STRESSES APPLIED | | | | | | |
|---|---|---|---|---|---|---|---|
| **TEST METHOD** | **Heat** | **Salt** | **Humidity** | **Light** | **CYCLIC** | **STANDARD** | **COMMENTS** |
| Salt Fog | Yes | Yes | Yes | No | Constant | ASTM B 117 | Developed to mimic marine exposure |
| Humidity Testing | Yes | No | Yes | No | Constant | ASTM D 2247 | Test water resistance |
| Humidity Testing | Yes | No | Yes | No | Constant | ASTM D 4585 | Includes drying period using dry forced air |
| Light/ Condensation | Yes | No | Yes | Yes | Cyclic | ASTM D 4587, ASTM G 53 | Care in selection of UV bulbs |
| Artificial Weathering | Yes | No | Yes | Yes | Cyclic | ASTM G 23, Carbon Arc; ASTM G 26, Xenon Arc | Shielding if light source reqiured |
| Weathering | ---- | ---- | ---- | ---- | ---- | ASTM G 26, Xenon Arc | Shielding if light source required |
| $SO_2$/Moisture Exposure | Yes | Yes | Yes | No | Cyclic | ASTM G 87 | Intended for testing of coil coatings, alloys |
| Immersion Testing | Yes, Optional | No | No | No | Constant | ASTM D 870 | |
| Immersion, Chemical | Yes, Optional | Chemical Exposure | Yes, Above Fluid Line | No | Constant | ASTM D 868, NACE TM 0174 | Testing of linings |
| High Temperature/ High Pressure Immersion | Yes, Optional | Yes, Optional | No | No | Constant | Proposed Standard | Accelerates blistering failure, used by marine |
| Cyclic Salt Spray | Yes | Yes | Yes | No | Cyclic | ASTM G 85 | Forced air drying of coatings, constant temperature |
| Cathodic | No | Yes | No | No | Constant | ASTM G 8 | |
| Cyclic Salt Spray | Yes | Yes | Yes | No | Cyclic | ASTM G 85, Appendix A5 | Uses special weak salt solution, drying of panels by heating of chamber and passage of dry air; salt fog at 25°C, drying at 35°C |
| Combined Cyclic Salt Spray and UV/Condensation | Yes | Yes | Yes | Yes | Cyclic | ASTM D 5894 | |
| Freeze-Thaw Humidity | Yes | No | Yes | No | Cyclic | ASTM D 2246 | Used in conjunction with UV exposure as an option |
| Freeze-Thaw, Salt Fog, Humidity Testing | Yes | Yes | Yes | No | Cyclic | None | |
| Light, Immersion, Humidity Exposure "Envirotest" | Yes | Yes, Optional | Yes | Yes | Cyclic with Immersion | Standard in Preparation | |
| Accelerated Outdoor | Yes | No | Ambient | Yes | Natural Cycle | ASTM D 4141 | |
| Acclerated Outdoor | Yes | Yes | Ambient | Yes | Natural Cycle | None | Panels sprayed with salt or acid solution at regular intervals |

Provided by : www.spic.ir Licensee: NISOC Library

# SSPC: The Society for Protective Coatings

# TECHNOLOGY UPDATE NO. 6

## Chemical Stripping of Organic Coatings From Steel Structures

## 1. Scope

This document defines chemical strippers and discusses their use for removing existing conventional organic coatings from steel structures. Chemical stripping is recognized as one of a number of technologies available for the removal of existing coatings prior to repainting.

## 2. Description and Use

Chemical stripping involves application of a chemical to existing paint, allowing it to dwell for a period of time to attack the organic binder, removing bulk paint/stripper residues, and properly cleaning the steel substrate prior to repainting. Section 3 below describes methods used to identify which type of stripper will work most effectively, and typical application and removal options. Section 3 also presents containment and disposal options for stripper wastes.

## 3. Discussion

**3.1 GENERIC STRIPPER TYPES AND USES:** The chemical composition of strippers falls into two distinct generic categories. The first group is generally a blend of low molecular weight solvents known as “bond breakers.” The stripper solvents break existing paint bonds and “wrinkle” the paint so that it can be removed from the surface. Where old paint exists in multiple coats, bond breakers may require multiple applications for complete removal. Bond breakers may contain toluene, methylene chloride, or methyl ethyl ketone, which can remove paint faster, but may result in worker exposure to potentially hazardous chemicals and therefore require special worker protection to maintain exposure below permissible exposure limits (PELs). Bond breaking strippers may also be comprised of compounds such as N-methyl-pyrrolidone (NMP) or dibasic ester (DBE). These strippers work more slowly but are generally less toxic and may require less stringent worker protection. The bond breakers are generally selected for use in removing all coatings except oil-based, inorganic, or metallic coatings.

The second category of chemical strippers is the caustics. These strippers contain one or more common caustic chemicals, such as sodium, calcium, and magnesium hydroxide. Rather than attacking bonds between coating layers or between coating and substrate, caustics soften the entire paint system. Their use is generally restricted to oil based paint systems, typical of those found on structures such as bridges and tank exteriors. These older structures more commonly contain lead-based primers, on which caustics have proven to be quite effective. An exception to the use of caustics on oil based paint exists where aluminum flake pigment is present. Caustics cause aluminum to produce bubbles of hydrogen at the interface between the stripper and the substrate, rendering the stripper ineffective. For these applications, the aluminum-containing coatings must first be removed using one of the bond breakers, typically an NMP based product.

**3.2 STRIPPER SELECTION:** Chemical stripper selection is based upon a number of variables, all of which can be assessed by performing patch tests on the existing paint system. Typical variables include thickness of the existing coating, ambient temperature and humidity, presence of aluminum paint, and time restrictions on the potential job site such as traffic control restrictions. Since these variables do exist, it is highly recommended that a representative from the stripper manufacturer, or his agent, be present to assist in conducting patch tests. Changes to application parameters (such as amount applied and dwell time) can affect the results of a patch test. A trained manufacturer’s representative can assist in proper assessment of patch test results. To account for existing paint thickness variations on a candidate structure, patch tests should be conducted in more than one location and each should cover at least one square foot of surface.

The stripper types described in Section 3.1 generally work best at ambient temperatures above 10 °C (50 °F) and at high relative humidity. When using the bond breaker strippers, application thicknesses and dwell times will vary. However, products with solvents of low molecular weight and thus greater volatility have far shorter dwell times than the less volatile NMP/DBE products. Also, the latter products are generally lower in volatile organic compound (VOC) solvent content. As mentioned in Section 3.1, the bond breakers frequently require multiple applications to remove existing paint systems completely.

The caustics will typically remove up to 500 micrometers (20 mils) of existing oil (e.g., alkyd) paint systems using a stripper wet film thickness of 1600 micrometers (63 mils). Coverage rates at 1575 micrometers (62 mils) application thickness average between 0.5-0.6 $m^2$/L (20-25 sq. ft/gal) for caustic strippers. Coverage rates will decrease in direct proportion as application thickness increases. Dwell time for alkyd coatings will vary between 4 and 24 hours, depending on their oil length. Variations of the existing paint thickness as well as weather conditions can greatly impact dwell times. Properly supervised patch testing can accom-

Provided by : www.spic.ir Licensee: NISOC Library

plish assessment of all the variables and will provide definitive information regarding performance of stripper type and cost for each application. It is recommended that service environment conditions during patch test and stripper application be fully documented.

**3.3 CONTAINMENT:** Containment guidelines for chemical stripping involve the following considerations: containment during stripper application; during stripper removal; during surface preparation for painting; and during painting. Each of these considerations will vary based on geometry of the structure (tanks, bridges, pipelines) as well as on which methods are used for application and removal of the stripper. In general, the containment structure should be in accordance with SSPC-Guide 6 (Class 1C, 2C or 3C), and it should be constructed so as to prevent stripper residues from impacting the immediate environment. Typically, plastic sheeting, at least 150 micrometers (6 mils) thick, is resistant to the chemical strippers described above, and works adequately for most applications, if it can withstand any anticipated wind load. For some structures such as around the circumference of ground storage tanks, additional materials such as plywood may be employed to serve as a base for retaining solid stripper residues so they can be more easily transferred into waste containers. In addition, it is advisable to provide some means of containing any rinse liquids generated during stripper removal. Containment structures may or may not require forced air ventilation based on which type of stripper is used, the method of removing the stripper, potential exposures during pre-painting and painting operations, and project locale.

**3.4 WORKER HEALTH AND SAFETY:** Specific requirements for worker health and safety can be found by referring to the product specification sheets and material safety data sheets supplied by the chemical stripper manufacturer. Typically, caustic strippers are water based and therefore do not release significant airborne contaminants. However, since they are corrosives, they can cause skin burns. Materials that are chemically impervious must be used to protect eyes and skin. Solvent based strippers also require chemically resistant skin protection, and protection against airborne solvent vapors may be required. Depending upon the method of removal (see Section 3.6), airborne concentrations of toxic metals may be encountered when removing coatings containing lead or other toxic metals.

Specific respiratory and personal protective equipment requirements should be in accordance with all applicable OSHA standards.

**3.5 STRIPPER APPLICATION:** Procedures for applying chemical strippers vary based on geometry of the structure to be stripped, type of stripper used, and productivity desired. In general, strippers are spray applied using conventional paint pumps. Caustic strippers require pumps which are chemically resistant and can accommodate thicker materials. The caustics should be air sprayed but the bond breakers can be applied with airless pumps. Chemical strippers may also be applied using trowels or brushes although these tools will generally not allow for the thickness control which can be achieved by spraying.

Some caustic applications may require using a splatter coat prior to full application of the stripper. The splatter coat is a light, non-continuous application of the stripper which is allowed to dry prior to spraying the full stripper coating. The splatter coating is typically required on older alkyd paint systems, where the caustic causes accumulation of oil at the steel/coating interface, resulting in loss of stripper adhesion on vertical surfaces. The dried splatter coating will prevent this premature release and allow the stripper to complete its stripping cycle. The need for a splatter coating is typically discovered during the patch test cycle.

Production rates for strippers can vary greatly and should be determined based on patch tests and other variables listed above, but typically should be directly related to how much area can be cleaned following the dwell cycle. For example, if the dwell cycle is overnight, application will generally take place in the previous afternoon. The area sprayed should be restricted to that which can be properly cleaned prior to the next spray cycle. For tanks, using a three man crew, production rates are typically between 300 to 400 $m^2$ per day (3,000 to 4,000 sq. ft. per day) for a complete application/removal cycle, whereas for bridges and other structural steel of complex geometry, these rates will drop to between 100 to 200 $m^2$ per day (1,000 to 2,000 sq. ft. per day).

**3.6 STRIPPER REMOVAL:** Chemical stripper residues can be removed using a number of methods which include both hand and mechanical tools and rinsing or wiping. Choice of removal methods should be based on structure geometry, production rate desired, and collection of waste residues. When removing residues where bond breaker strippers have been used, rinsing is usually not required, but the surface may require a wipe prior to a second stripper application or subsequent surface preparation for painting. This step, if required, will be identified during patch testing.

Most older structures with lead paint will be chemically stripped using a caustic product. This process requires hand scraping the bulk residues using broad knives, followed by rinsing to remove any remaining lead primer residues. The rinsing step can be accomplished with wet sponges for smaller areas but for larger jobs, rinsing should be done with a system which produces a minimal amount of water. Typically, any airless paint pump using a 0.5 mm (0.02 in) tip, will generate a rinse stream of less than 1.25 L/min (0.33 gal/min) at 3.4 MPa (500 psi). This will suffice to remove any excess stripper residues with minimal water waste. Pressure washers are not recommended as they generate more pressure and water and their waste streams are more difficult to contain. Other mechanized removal processes

Provided by : www.spic.ir Licensee: NISOC Library

which can enhance productivity while minimizing waste include ice blasting, carbon dioxide ($CO_2$) blasting, and vacuum rinsing.

During stripper removal, care must be taken to direct all wastes, including rinse liquids, to the containment area. Certain structures may lend themselves to separation of liquids and solids. Where applications produce excessive liquids during the removal cycle, stripper residues can be filtered to facilitate easier disposal (see Section 3.7 below).

Following removal of caustic chemical stripper residues, steel surfaces will typically exhibit some degree of alkalinity. This alkalinity may require reduction prior to painting, based on the chemistry of the coating to be applied. Surface pH can be reduced, if required, with either a light application of dilute acetic acid or with a water rinse. These options should be discussed with the paint manufacturer so that surface condition prior to painting can be agreed upon. In addition to proper pH, additional inspection criteria should include visual inspection of the total work area to determine that all visible stripper residues have been removed.

**3.7 STRIPPER WASTE DISPOSAL:** Waste products from chemical stripping projects can exhibit a number of different characteristics depending on which stripper product is used, and how much lead or other hazardous materials exist in the old paint system. Typically, where caustic strippers are used on old oil paint systems (which can contain lead levels up to and above fifty percent by weight), the resulting waste stream will likely test above the toxic chemical leachate procedure (TCLP) limit for lead and may be above corrosivity (pH) limits. In these cases, typical handling involves reduction of pH and stabilization of the lead prior to disposal. Refer to SSPC-Guide 7 for further information on the testing, handling, storage treatment and disposal of the resulting waste streams.

On-site treatment of hazardous waste may require special approval. Contact local regulatory agencies prior to performing on-site stabilization. Wastes generated when using the bond breaker solvents may require different treatment protocol depending on which solvents are present. Treatment for these wastes may require incineration of the organic residues prior to stabilization of lead. Liquid waste must be tested for leachable lead and corrosivity, and if above regulatory limits, will require treatment and filtration.

Following filtration, some wastes might be able to be taken to a local publicly owned treatment works (POTW) facility for disposal, depending upon the POTW's influent standards. All federal and local disposal guidelines should be assessed prior to disposal.

**3.8 ADDITIONAL FACTORS AFFECTING THE USE OF CHEMICAL STRIPPERS:** The biggest advantage gained from using chemical strippers is that the process does not generate dust. This may be significant when the coating being removed contains lead or other hazardous materials. Containment requirements are generally low to moderate and are designed to prevent the strippers and stripper waste products from impacting the surrounding environment.

Coating removal is very effective for flat surfaces and becomes less effective as the structure geometry becomes more complex. Production rates for chemical stripping vary based on production crew size and geometry of the structure.

Suitability of the chemically stripped steel surface for subsequent painting ranges from poor to excellent depending on the quality of the original surface preparation and the extent of degradation which may have occurred during service. Chemical stripping does not create a surface profile on steel substrates nor will it remove adherent rust and mill scale, or existing thermal spray metallic coatings. The condition of the original surface can influence the choice of coating used to re-coat the steel, and additional processing such as abrasive blasting, or power tool cleaning, combined with application of a surface-tolerant prime coat, may be required.

## 4. Disclaimer

This technology update is for information purposes only. It is neither a standard nor a recommended practice. While every precaution is taken to ensure that all information furnished in SSPC technology updates is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the technology update itself.

## 5. References

Carroll, Courtney. "Chemical Stripping: A Viable Alternative," Achieving Quality in Coating Work, Proceedings from the SSPC 92 Seminars (SSPC 92-13). (Pittsburgh: SSPC, 1992), pp. 212-215.

"Chemical Stripping Removes Lead Paint from Water Tower," JPCL Vol. 13, No. 3 (March 1996), pp. 43-44.

"Chemicals Safely Remove Lead Paint from Tanks" Aboveground Tank Update, CEEM Publications, (December 1991).

"Lead Paint Removed from Water Tank Using Chemical Stripper," JPCL, Vol. 8 No. 10, (October 1991), pp. 41-44.

Mickelsen, R. Leroy and Walter M. Haag. "Removing Lead-Based Paint from Steel Structures with Chemical Stripping," JPCL, Vol. 14, No. 7 (July 1997), pp. 22-29.

"Minnesota DOT Tests Chemical Stripper," JPCL, Vol. 12 No. 2, (February 1995), pp. 58-59.

Rodkey, James L. "Lead Paint Removal at Reasonable Cost by Chemical Stripping," Industrial Lead Paint Removal: Compliance and Worker Safety, Proceedings of the Fifth Annual Conference on Lead Paint Removal (SSPC 92-04). (Pittsburgh: SSPC, 1992), pp. 21-36.

Trimber, Kenneth A., Industrial Lead Paint Removal Handbook, Second Edition. (Pittsburgh: KTA-Tator, Inc., 1993).

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# TECHNOLOGY UPDATE NO. 7

## Conducting Ambient Air, Soil, and Water Sampling During Surface Preparation and Paint Disturbance Activities

## 1. Scope

1.1 This technology update describes a variety of air, water and soil/sediment monitoring methods used for measuring emissions of lead, particulate matter, or dust emissions during surface preparation operations, construction or painting activities. The monitoring guidelines presented in this document provide methods for assessing the efficacy of work site engineering controls (e.g., containment systems) implemented to protect the public and the surrounding environment and to assess the impact of lead or other toxic metals, dust, and PM-10 emissions from project operations, equipment and other potential emission generating operations (e.g., waste handling operations).

### 1.2 STATEMENT OF PURPOSE

**1.2.1** This technology update describes methods and equipment used for assessing emissions during surface preparation and other emission generating operations and to assure that the controls in place are adequate for protecting the public, the environment, and adjacent personnel. The intent of this report is to present the user with a variety of methods of testing that may be appropriate for monitoring project emissions, and describe the information provided by each of the monitoring methods. The criteria used for selecting a particular monitoring method must be determined on a case-by-case basis but should include consideration of the type of surface preparation operation being performed; the dust producing nature of the operation; the type of containment; proximity of the work area(s) to the public; sensitive environmental receptors; adjacent personnel; the amount of lead or other toxic metals present in the coating; and other site-specific characteristics.

**1.2.2** The emission assessment methods presented herein are primarily intended to provide guidance to designers, engineers, and specifiers when conducting surface preparation or lead-paint removal activities. However, the methods may be applicable to demolition, retrofitting, and other construction activities where lead, dust, or fume emissions may be generated.

**1.3 Intended Users:** This technology update is intended to be used by facility owners, government agencies, engineers, specifiers, designers, environmental monitoring firms, and contractors. The guidelines may also be used by other responsible parties conducting similar activities.

**1.4** Regulations: The primary federal regulations currently addressing surface preparation activities that potentially result in fugitive emissions of lead or dust include: the Clean Air Act (CAA), and all amendments such as the National Ambient Air Quality Standards (NAAQS), the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), all mandated by the Environmental Protection Agency (EPA), and the Occupational Safety and Health Administration (OSHA) Interim Final Rule on Lead Exposure in Construction Industry, 29 CFR 1926.62.

The Clean Air Act states that air quality standards be established for “criteria” pollutants through the NAAQS. Airborne lead and particulate matter with an aerodynamic diameter of less than ten (10) micrometers (e.g., PM-10) are two of six originally identified criteria pollutants, both of which have been associated with the surface preparation activities involving the disturbance of lead-based paint.

## 2. Application

**2.1 USE OF THE TECHNOLOGY UPDATE:** This Technology Update is intended to provide assistance in selecting a method or methods of emission monitoring to use during surface preparation projects. Once the method is selected, the Technology Update presents direction on how to perform the emission assessments, and how to interpret the information provided by the monitoring method.

### 2.2 EMISSION MONITORING METHODS

The methods presented in this report are:

**2.2.1 TSP-Lead:** This method is performed using high-volume air samplers to monitor lead in the form of total suspended particulate (TSP-lead). Monitoring is performed in accordance with 40 CFR Part 50, Appendix B. Analysis is performed in accordance with 40 CFR 50, Appendix G. Acceptance criteria is typically based upon the NAAQS criteria for lead of 1.5 micrograms per cubic meter ($\mu g/m^3$) as a ninety day average.

**2.2.2 Area or Perimeter Air Monitoring for Lead:** This method is performed using low- or high-volume personal or area air samplers to monitor for lead at the perimeter of the work area. Monitoring and analysis is performed in accordance with NIOSH Method 7082 or equivalent. The

Provided by : www.spic.ir Licensee: NISOC Library

acceptance criteria is typically based upon the OSHA Action Level for lead of 30 micrograms per cubic meter ($\mu g/m^3$) as an eight hour Time Weighted Average (TWA), or comparable Action Levels for other toxic metals present.

**2.2.3 PM-10:** This method is performed using high-volume air samplers to assess particulate matter with an aerodynamic diameter of less than ten (10) micrometers. Monitoring and analysis is performed in accordance with 40 CFR Part 50, Appendix J. Acceptance criteria is typically based upon the NAAQS criteria for PM-10 of 150 micrograms per cubic meter ($\mu g/m^3$) as a 24 hour average. NOTE: SSPC does not recommend the PM-10 method because it has been determined that the TSP method provides more accurate data. However, because the PM-10 method is referenced in current federal regulations, it is included here for the sake of completeness. See Section 7.1 and Appendix B.

**2.2.4 Visible Emission Evaluations for Total Dust - Timing:** This method is performed by measuring the duration of the visible emission of total dust. Visible emission evaluations are performed in accordance with 40 CFR Part 60, Appendix A, Method 22. The acceptance criteria is typically based upon the classifications of emissions based on the total duration of emissions established as part of SSPC-Guide 6.

**2.2.5 Visible Emission Evaluations for Total Dust - Opacity:** This method is performed by assessing the opacity of observed emissions of total dust. Opacity emission evaluation is performed in accordance with 40 CFR Part 60, Appendix A, Method 9. The acceptance criteria is typically an allowable opacity based upon state and local requirements.

**2.2.6 Soil Sampling:** Sample collection and analysis is performed in accordance with the procedures established in SSPC-Guide 7. Analysis is typically performed in accordance with EPA Method 3050. The acceptance criteria are typically based upon a minimum statistical increase in lead content using geometric means, the Student T-test, or the EPA residential lead guidelines. This method is performed by collecting pre- and post- project samples and performing a statistical comparison between the sample sets.

**2.2.7 Water and Sediment Sampling:** Sample collection is typically performed at the surface of the water or in sediment where the depth of the water is less than 18 feet. Analysis is typically performed in accordance with EPA Method 3050. The acceptance criteria is typically upon a minimum statistical increase in lead content using geometric means or the Student T-test.

**2.2.8 Real-Time Monitoring for Total Dust:** This method is performed by using hand-held or mounted samplers to monitor for respirable or total dust. There is no regulatory standard assigned to this method. The acceptance criteria is typically established by the specifier. This method is included as Appendix A.

**2.3 MONITORING FREQUENCY**

There are five typically specified monitoring frequencies:

**2.3.1 No Monitoring:** Monitoring of emissions is not performed.

**2.3.2 Monitoring for Complaints:** Emission monitoring is performed when a complaint is received. The duration of monitoring is then determined.

**2.3.3 Job Initiation Monitoring:** Emission monitoring is performed during the initial phases of the project. The total number of monitoring days is determined and established in the specification, e.g., five of the first ten work days. No further monitoring is performed if the project is determined to be in compliance with the acceptance criteria. Monitoring is continued if the project is not in compliance with the acceptance criteria until controls are modified and it is shown to be in compliance.

**2.3.4 Job Initiation and Periodic Monitoring:** Monitoring is performed at the beginning of the project and at regular intervals thereafter. Initial monitoring is performed in accordance with 2.3.3. Monitoring is repeated at a predetermined interval, i.e., one week per month. The monitoring frequency is determined by the specifier or user. In the case of soil, water, and sediment sampling, samples are typically collected pre- and post-project (with occasional mid-project samples).

**2.3.5 Continuous Monitoring:** Monitoring is performed for the duration of the dust producing operations.

**2.4 SELECTION OF MONITORING METHODS**

**2.4.1** The selection of emission monitoring methods for a particular project will be dependent upon a variety of factors. Each project will have unique characteristics which must be considered by the specifier. Factors to be considered include:

a. The type of emissions, if any, that may be generated by the project. Typically these would include total dust, PM-10, lead dust, or fume.

b. The dust generating potential of the method of surface preparation being performed.

c. The type and level of containment being specified.

d. The metals (e.g., lead) content of the coating being removed. Consider monitoring for other metals present in the paint such as cadmium, chromium, and arsenic.

e. The proximity of adjacent personnel.

f. The proximity of the public, particularly day care centers, schools, high density populations and target housing and other sensitive receptors.

g. The proximity of sensitive environmental receptors (e.g., wetlands, oyster beds).

h. The duration of the project.

Provided by : www.spic.ir Licensee: NISOC Library

i. Specific state or local regulatory requirements.

**2.4.2** The type of emission monitoring selected will also be dependent upon the objective of the air monitoring program. Objectives may include:

**2.4.2.1 Compliance With NAAQS for TSP-Lead and PM-10:** It must be noted that while TSP-Lead and PM-10 monitoring methods are based upon the NAAQS allowable limits, such monitoring is often not being performed to assure strict compliance with NAAQS. (The NAAQS was not prepared in a way that is directly applicable to short-term field maintenance painting projects.) These methods are most often conducted to assure that the health and welfare of the public is not being impacted and to establish documentation for liability protection of the owner or contractor.

**2.4.2.2 Immediate Feedback:** Methods that give immediate results for total dust include: visible emission evaluations using timed measurements, visible emission evaluation using opacity measurements and real-time monitoring. Visual methods do not provide qualitative information on TSP-Lead and PM-10 values; however, they do provide a means of assessing emissions immediately and may provide information on the level of controls provided by containment systems.

**2.4.2.3 Obtaining Quantitative Results:** These methods include: high-volume air sampling for TSP-Lead and PM-10, and area sampling for airborne lead emissions. These methods provide quantitative results regarding emissions that can be compared to the NAAQS or OSHA Action Level; however, these methods require laboratory analysis and results are typically not available for a minimum of 72 hours.

**2.4.2.4 Protection:** Protection from potential civil liability arising from emissions from the surface preparation or lead-paint removal project may also be an objective.

**2.4.3** The type of emission monitoring selected will also be dependent upon other factors including: cost, mobilization limitations, and project duration.

**2.4.4** A combination of immediate and quantitative results may be appropriate in some situations.

**2.5 SELECTION OF RECOMMENDED MONITORING METHOD AND FREQUENCY**

**2.5.1** Once all of the factors have been identified and considered, select the monitoring method(s) and frequencies, if it is determined that monitoring will be performed.

## 3. Definitions and Acronyms

**Action Level:** Employee exposure, without regard to the use of respirators, to an airborne concentration of a contaminant in micrograms per cubic meter of air ($\mu g/m^3$) calculated as an eight hour time-weighted average (TWA). Unless otherwise specified by regulation, the Action Level of a material will be equivalent to one half of the OSHA Permissible Exposure Limit (PEL) for that substance. The Action Level for lead is 30 $\mu g/m^3$.

**Adjusted Daily Allowance (ADA):** Concentration of TSP-lead or PM-10 allowed per day, accounting for the number of hours of emission-generating activities in a 24-hour period. For TSP, the ADA is calculated by multiplying the DA by a factor of 24/H. For PM-10, the ADA is calculated by multiplying the NAAQS PM-10 24-hour standard of 150 $\mu g/m^3$ by a factor of 24/H. In the above calculation, H is the number of hours of emission-generating activities in a 24 hour period.

**Adjusted Quarterly Average Allowance (AQAA):** Average concentration of TSP-lead allowed per 90-day period, accounting for the number of hours of emission-generating activities during the same 90-day period, calculated by multiplying the NAAQS TSP 90-Day Standard of 1.5 $\mu g/m^3$ by a factor of 2160/H, where H is the number of hours of emission-generating activities in the previous 90 days (2,160 hours). It should be noted for short duration periods the AQAA may be too high. In these cases, the specifier should select a reasonable DA, ADA, or AQAA.

**CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act (commonly called "Superfund"):** Federal laws addressing the cleanup of hazardous waste sites. Amended in 1986 by the Superfund Amendments and Re-Authorization Act (SARA). EPA implementing regulations are contained in 40 CFR 300-373.

**Containment System:** Enclosure built around hazardous material removal areas designed to contain hazardous material debris and prevent emissions to the environment.

**Daily Allowance (DA):** Concentration of TSP-lead in air in $\mu g/m^3$ allowed per day, accounting for the number of days of non-blasting activities in a 90-day period; calculated by multiplying NAAQS TSP 90-day standard of 1.5 $\mu g/m^3$ by a factor of 90/PD, where PD is the number of days of blasting activity in a 90-day period. It should be noted for short duration periods the AQAA may be too high. In these cases, the specifier should select a reasonable DA, ADA, or AQAA.

**Debris and Dust Containing Hazardous Materials:** Dust and debris generated during the project which contains hazardous material (e.g., lead or other toxic metals) in any amount, including but not limited to pulverized paint, spent abrasive, filters (wet and dry), and containment materials upon which hazardous materials are still present.

**Discharge:** Accidental or intentional spilling, leaking, pumping, pouring, emitting, emptying, or dumping of hazardous material or waste into or on any land, water or airspace.

**Dust Collection:** Mechanical ventilation system designed specifically for the containment, capture, and removal of airborne particulate from a containment. A dust

Provided by : www.spic.ir Licensee: NISOC Library

collection system shall include duct work, plenums and/or hoppers, and dust collector(s) for the removal of hazardous materials from the airstream prior to discharging to the atmosphere.

**Emission:** A release of material to the air, water, or ground.

**EPA:** The U.S. Environmental Protection Agency. EPA regulations are contained in Title 40 of the Code of Federal Regulations (40 CFR).

**Lead:** The word "lead" when used in this guide means elemental lead, all inorganic lead compounds and a class of organic lead compounds called lead soaps. Lead is a heavy metal at room temperature and pressure and is a basic chemical element. It can combine with various other substances to form lead compounds.

**Lead-based Paint:** Definitions vary depending upon industry or use. For the purpose of this guide, monitoring for lead may be considered when lead in any amount is detected in the paint in accordance with the OSHA, Lead in Construction Standard. Per 16 CFR 1303, "Ban of Lead-Containing Paint and Certain Consumer Products Bearing Lead-Containing Paint", a paint cannot be manufactured for consumer use if it contains 0.06% (600 ppm) or greater lead by weight. Abatement in public housing is triggered at 0.5% (5,000 ppm) or 1.0 $mg/cm^2$.

**µg/m³:** micrograms per cubic meter of air. Common units for reporting airborne concentrations of lead.

**NAAQS:** National Ambient Air Quality Standards. Federal regulations which establish limits on allowable pollutants in the ambient air. Lead (TSP-Lead) and particulate matter (PM-10) are included. Regulations are found in 40 CFR 50.

**National Institute for Occupational Safety and Health (NIOSH):** Federal agency which conducts research on safety and health issues, and tests and certifies respirators.

**Occupational Safety and Health Administration (OSHA):** Safety and health standards are contained in Title 29 of the Code of Federal Regulations, Parts 1910 and 1926 (29 CFR 1910 and 29 CFR 1926).

**PM-10:** Particulate matter with an aerodynamic diameter of 10 micrometers or less in size.

**Parts Per Million (PPM):** Common units for reporting a concentration of a specific substance in volume to volume or mass to mass ratios (e.g., concentration of lead contained in paint film reported as mass of lead to the total mass of paint).

**Permissible Exposure Limit (PEL):** Employee exposure, without regard to the use of respirators, to an airborne concentration of contaminant in micrograms per cubic meter of air ($\mu g/m^3$) calculated as an eight hour time weighted average (TWA). The PEL for lead is 50 $\mu g/m^3$. A formula is used to calculate the PEL if an employee is exposed to lead for more than 8 hours in any work day. The employee's allowable exposure to lead, as a time weighted average (TWA) for that day, is reduced according to the following formula:

Allowable Employee Exposure in $\mu g/m^3$ =

400 ÷ Number of Hours Worked in the Day

**Regulated Area:** Area identified by physical markings to indicate the zone(s) where airborne concentrations of hazardous materials exceed, or can be expected to exceed, the Action Level.

**Resource Conservation and Recovery Act:** RCRA regulations address waste handling and disposal and are found in 40 CFR 240 through 280.

**TSP:** Total Suspended Particulate

**Time Weighted Average (TWA):** This is the employee's average exposure to airborne contaminants in any eight hour work day.

## 4. Reference Documents

**4.1** The standards and references in this technology update are listed in Sections 4.4 through 4.8 and form a part of this update.

**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 the cited reference standards and this document, the requirements of this technology update shall prevail.

**4.4 SSPC PUBLICATIONS:**

| | |
|---|---|
| **Guide 6** | Guide for Containing Debris Generated During Paint Removal Operations |
| **SSPC 93-02** | Industrial Lead Paint Removal Handbook, 2nd Edition, Volume I |
| **SSPC 95-06** | Project Design, Industrial Lead Paint Removal Handbook, Volume II |

**4.5 CODE OF FEDERAL REGULATIONS (CFR):**

| | |
|---|---|
| **29 CFR 1926** | Occupational Safety and Health Regulations for Construction |
| **29 CFR 1926.55** | Gases, Vapors, Fumes, Dusts, and Mists |
| **29 CFR 1926.62** | Lead |
| **40 CFR 50** | National Primary and Secondary Ambient Air Quality Standards |
| **40 CFR 58** | Ambient Air Quality Surveillance |
| **40 CFR 60, App. A** | |
| **Method 9** | Visual Determination of the Opacity of Emissions from Stationary Sources |
| **Method 22** | Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Fires. |

Provided by : www.spic.ir Licensee: NISOC Library

**4.6 NIOSH METHODS:**

| | |
|---|---|
| **Method 7082** | Lead |

**4.7 EPA METHODS:**

| | |
|---|---|
| **SW 846** | Test Methods for Evaluating Solid Waste Physical/Chemical Methods |
| **Method 3050** | Acid Digestion of Sediment, Sludge, and Soils |
| **EP/600/R-94/038b** | Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Specific Methods, Section 2.8 (Lead) and 2.11 (PM-10). |

**4.8 AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA)**:

Environmental Lead Proficiency Analytical Testing Program (ELPAT)

Environmental Lead Laboratory Accreditation Program (ELLAP)

Proficiency Analytical Testing Program (PAT) for metals analysis

Laboratory Accreditation for Metals Analysis

## 5. TSP-Lead Monitoring

**5.1 DESCRIPTION OF METHOD:** This method specifies the use of high volume air samplers for determination of lead in air suspended particulate matter as defined by the EPA in 40 CFR Part 50, Appendix G. The method is a means to determine compliance with ambient air concentrations as prescribed in EPA's Primary and Secondary National Ambient Air Quality Standards (NAAQS) for lead. The method is also used as a quantitative means of documenting the effectiveness of the surface preparation operation containment system and verifying that the public is not being impacted by the surface preparation operations.

**5.2 MATERIALS AND EQUIPMENT**

**5.2.1** The following equipment is commonly used:

1. High volume air samplers designed in accordance with 40 CFR 50, Appendix B, Item 7, that are capable of drawing ambient air at a constant flow rate of between 39 cubic feet per minute (CFM) and 60 CFM for a 24 hour period through a glass fiber filter at a uniform face velocity.
2. Slack tube (water column monitor).
3. A whirling hygrometer (sling psychrometer).
4. Altimeter (barometer).
5. A wind velocity and direction indicator.
6. Sampler calibration kit.
7. An electrical source of sufficient power and duration to operate the specified high volume air samplers for a 24 hour period. It should be noted that the power source must be close enough to the monitors and have sufficient amperage to maintain the required uniform face velocity.
8. At a minimum, twelve (12) gauge extension cords and ground fault circuit interrupters (GFCIs) should be used to maintain necessary amperage and prevent damage to motors during power surges.

**5.2.2** The following materials are required:

1. Glass fiber filters for sample collection.
2. Manila or glassine envelopes.
3. Appropriate sample collection and field data forms.
4. Recorder charts.
5. Clean, dry, powder-free surgical gloves may be worn to prevent contamination of filters when handling them.

**5.3 SITING AND NUMBER OF MONITORING STATIONS**

**5.3.1** Install sampling stations at locations to measure community exposure to any airborne lead escaping from the containment as shown in Figures 1 through 4.

**5.3.2** Do not place samplers near the source of local lead or particulate emissions or under the drip lines of trees.

**5.3.3** Siting of ambient air monitors is typically performed on a case-by-case basis. Additional monitoring guidance can be found in 40 CFR 58, Ambient Air Quality Surveillance, Probe Siting Criteria. These criteria provide guidance for placing ambient monitors on fixed sites.

**5.3.4** Further guidance for placement on industrial painting projects can be found in *Project Design, Industrial Lead Paint Removal Handbook, Volume II* (SSPC 95-06).

**5.4 PROCEDURE**

**5.4.1** Operate the sampler in accordance with the manufacturer's instructions.

**5.4.2** Calibrate the sampler in accordance with manufacturer's instructions and Section 5.11 herein.

**5.4.3** Sample filters should be inspected and approved by the laboratory.

**5.4.4** Establish a filter information record and assign a unique identification number to each filter prior to field sampling.

**5.4.5** Prior to installation in sampler, place a light source behind each sample filter and inspect for tears, pinholes, particles, and other irregularities and discard the sample filter if a defect is found.

**5.4.6** Install the filter in the sampler as directed by the sampler manufacturer.

**5.4.7** Turn on the sampler and wait a minimum of five minutes until the flow rate is stabilized. Record site information (field technician, date, site location, sampler location, ambient temperature, barometric pressure, wind speed, wind direction, and general weather conditions).

**5.4.8** Determine sampler flow rate from the flow recorder or for volumetric flow controlled samplers by using the water manometer readings and the lookup table specific

Provided by : www.spic.ir Licensee: NISOC Library

**Figure 1. Ambient Air Monitor Siting**
**Establishing a Monitoring Zone[1]**

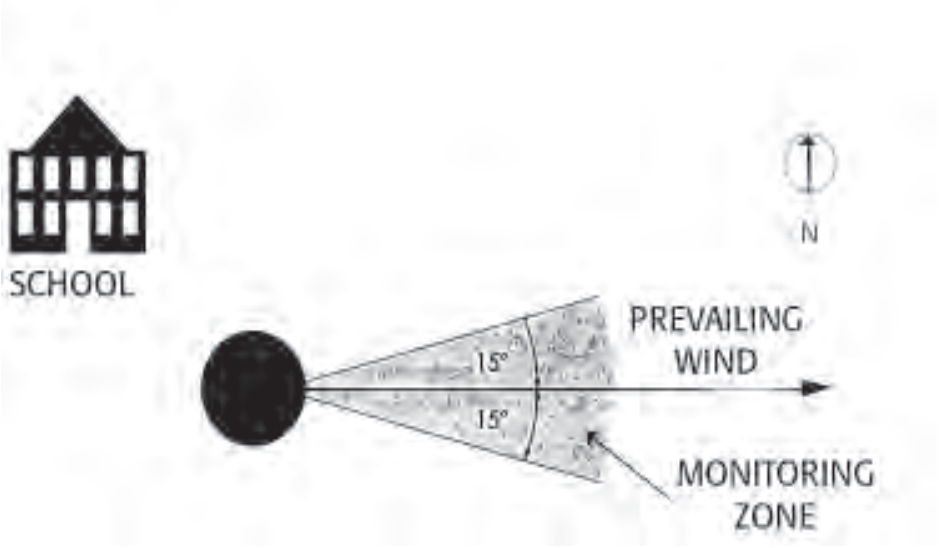



*Figure 1. The prevailing wind is first determined, and an arc approximately 15° on either side of th prevailing wind is designated as the monitoring zone. Site-specific conditions may alter the size of this zone. Site-sensitive receptors (e.g., schools) are also identified as potential monitoring sites.*

---

**Figure 2. Ambient Air Monitor Siting**
**Structures Less than 20 Feet in Height**

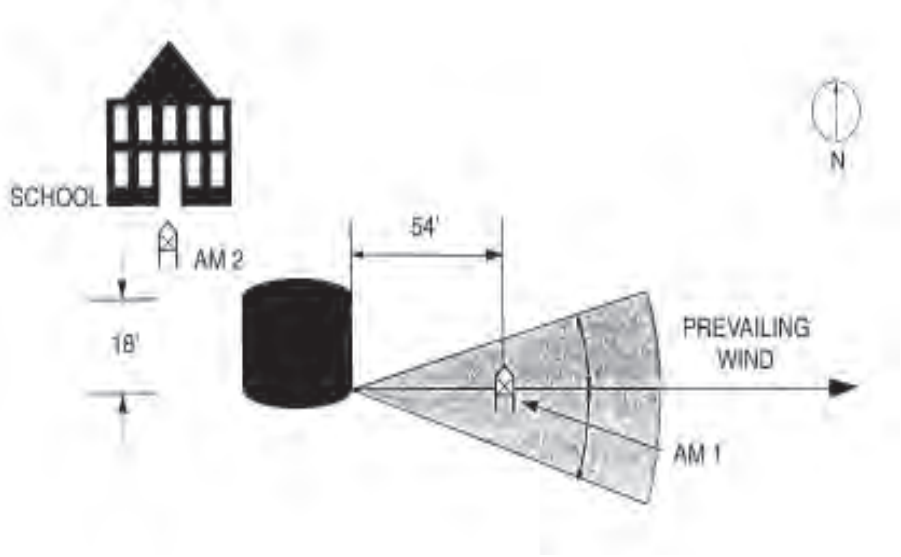



*Figure 2. For structures less than 20 feet in height, at least one monitoring site is positioned downwind at a distance equivalent to three times the height of the surface. Site-specific conditions may alter the location. Sensitive receptors (e.g., schools) are also designated for monitoring.*

[1] Figures 1 through 4 are reproduced from *Project Design, Industrial Lead Paint Removal Handbook, Vol. II,* copyright Technology Publishing Company, 1994, with permission.

Provided by : www.spic.ir Licensee: NISOC Library

**Figure 3. Ambient Air Monitor Siting**
**Structures 20 Feet to 100 Feet in Height**

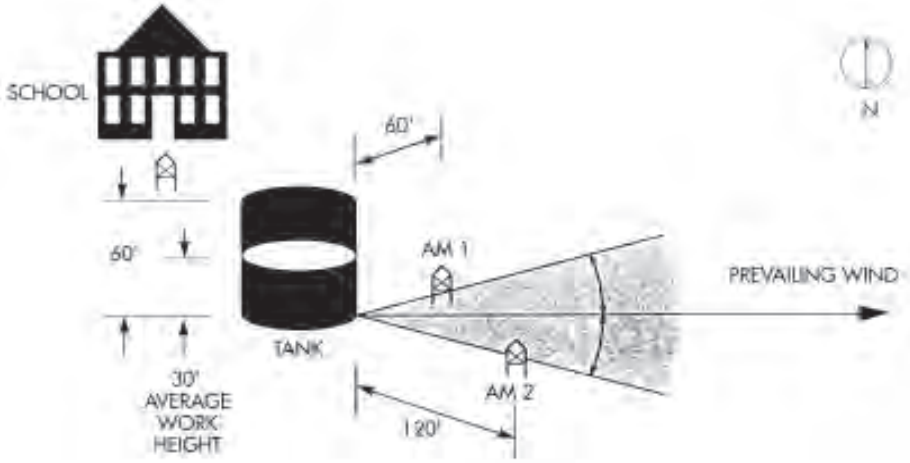



*Figure 3. For structures 20 feet to 100 feet in height, a monitoring site is located approximately two times the height of the structure along one side of the zone. A second monitoring site is positioned along the other side of the zone at a distance roughly equivalent to two times the average working height on the structure. Site-specific conditions may alter the size of the monitoring zone and monitor siting locations. Again, site-sensitive receptors (e.g., schools) are designated as monitoring sites.*

---

**Figure 4. Ambient Air Monitor Siting**
**Structures Greater than 100 Feet in Height**

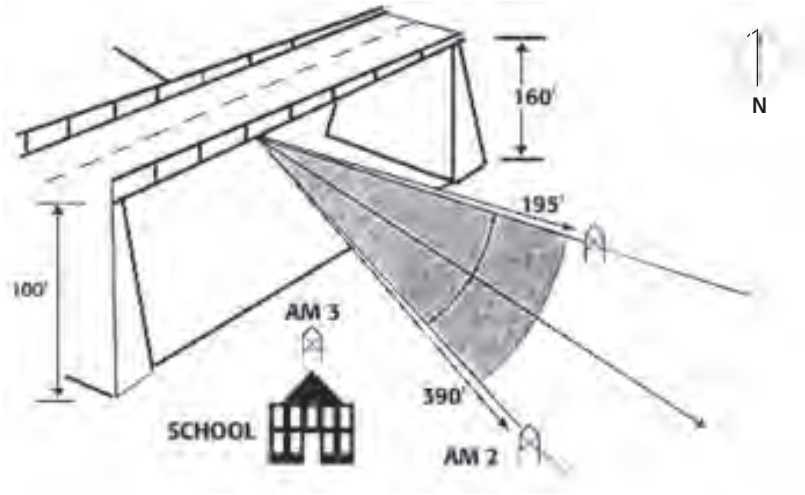



*Figure 4. For structures greater than 100 feet in height, a monitoring site is located approximately three times the average working height along one side of the zone. A second monitoring site is positioned along the other side of the zone at a distance roughly equivalent to 1.5 times the average working height. Site-specific conditions may alter the size of the monitoring zone and monitor siting locations. Again, sensitive receptors (e.g., schools) are designated as monitoring sites.*

Provided by : www.spic.ir Licensee: NISOC Library

to that monitor, in actual cubic meters per minute (CMM) or cubic feet per minute (CFM), in accordance with sampler manufacturer's instructions.

**5.4.9** Record sample information (i.e., start time, sample identification number, filter identification number, sampler serial number, and flow rate).

**5.4.10** Sample for the duration as specified in Section 5.7 herein.

**5.4.11** Calculate and record average flow rate (Q), in actual CMM or CFM, for the sampling period in accordance with sampler manufacturer's instructions. Record the sample end time and site information (ambient temperature, barometric pressure, wind speed, wind direction, and general weather conditions). Note any unusual activity that might affect the concentration of lead in air at the site (e.g., construction work other than the surface preparation activity).

**5.4.12** Remove the filter from the sampler, taking care to avoid contaminating the filter. When handling the filter, grasp the outer edge to avoid disturbance of particulate deposits. Filters should not be stacked or otherwise allowed to make contact with one another.

**5.4.13** Fold exposed sample filter lengthwise with the top (or exposed) side facing inward and place into a separate sealed glassine or manila envelope.

**5.4.14** Transmit the exposed sample filter, sample data sheet, and completed chain of custody form to the laboratory for analysis. If volume is being calculated by the laboratory, send flow recorder chart.

### 5.5 BACKGROUND MONITORING

**5.5.1** Frequently background monitoring is conducted to determine the preexisting emissions levels at the site. Background monitoring will often identify other sources of lead or dust emissions (such as traffic or industrial pollutants). Background sampling is typically conducted for one to five days dependent upon the projected duration of monitoring.

**5.5.2** Conduct background monitoring as follows to determine the contribution of other sources to the concentration of lead in air in the monitoring zone.

1. Immediately prior to surface preparation activities, install samplers as described in Section 5.3 and collect samples.

2. Use background results to assist in the interpretation of the project monitoring results.

### 5.6 OFF-HOURS MONITORING

**5.6.1** Ambient air monitoring for TSP-lead during industrial lead paint removal operations is often conducted for sampling durations less than the 24 hour periods regulated by the NAAQS, usually only during that part of the day when work activities on a job site may create dust emissions. To compare the measurements obtained during that sampling period to the 24-hour limits, an estimate may be collected which represents the portion of the day during which time monitoring (and presumably work activities) did not occur.

While background levels of TSP-lead determined prior to mobilization of site equipment may represent this off-hours period under certain conditions, and has been widely used in the past to represent this portion of the day, idle equipment and contaminated job site materials may provide some minor sources of emission during off-hours periods. Therefore, background levels recorded prior to site mobilization may be inappropriate to represent the unsampled portion of the 24 hour day.

**5.6.2** Conduct off-hour monitoring for eight hours (or equivalent to work duration) at the beginning of a project and consider additional measurements (once a month) thereafter for longer projects. Conduct off-hours monitoring during any nonproduction time period which represents typical off-hours conditions.

**5.6.3** Use the average of several days of off-hours ambient air monitoring in the computation of project monitoring results (Adjusted Daily Average).

### 5.7 DURATION OF MONITORING

**5.7.1** Monitoring is typically conducted during project activities or for a full twenty-four (24) hour duration. Contact local authorities to determine any monitoring duration requirements. Maintain quality assurance procedures as described in EPA 40 CFR 58, Appendices A and B, and EP/600(R-94/0388), Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. II, Ambient Air Specific Methods, Sections 2.8 (Lead) and 2.11 (PM-10).

**5.7.2** For monitoring project activities, collect samples beginning at least one half-hour prior to emission generating activities, and continuing for a minimum of one half-hour after emission generating activities have ended, including cleanup activities and moving or dismantling the containment.

**5.7.3** Cease sample collection only after all surface preparation operations have ceased and the surface preparation contractor has demobilized from the site.

### 5.8 QUALITY CONTROL AND CHAIN OF CUSTODY

**5.8.1** Maintain quality assurance procedures as described in EPA 40 CFR 58, Appendices A and B.

### 5.9 ANALYSIS OF SAMPLES

**5.9.1** Sample analysis should be performed by a laboratory approved by the owner. Laboratories performing analysis should be familiar with ambient air monitoring. Very few accreditations for TSP exist. Those available include the NYELAP (New York Environmental Laboratory Accreditation Program) and the National Performance Audit Program administered by Mantech and Environmental Technology, Inc. for the EPA. Accreditations that are similar include accreditation by the American Industrial Hygiene Association (AIHA) for metals.

Provided by : www.spic.ir Licensee: NISOC Library

**5.9.2** Sample analysis should be performed in accordance with 40 CFR 50, Appendix G.

**5.9.3** The mass concentration of lead in air suspended particulate matter during the monitoring period shall be computed as the total mass of collected lead divided by the volume of air sampled as follows:

1. Determine the initial and final flow rates from the continuous flow recorder or the sampler calibration curve. The calculated average flow rate, $Q_a$, is one half the sum of the initial and final flow rates.

2, Correct $Q_a$ to $Q_{std}$ where:

$$Q_{std} = Q_a \times \frac{P_a}{P_{std}} \times \frac{T_{std}}{T_a}$$

$Q_a$ = average flow rate

$P_a$ = actual pressure x (mm Hg)

$P_{std}$ = 760 mm Hg

$T_a$ = actual temperature

$T_{std}$ = 290 K

3. The total air volume sampled is calculated as

$$V = Q_{std} \times t$$

where:

V = Total air volume sampled, in CMM;

$Q_{std}$ = Average standard flow rate, in CMM; and

t = sampling time, in minutes

4. Calculate and report the TSP lead concentration as

$$P_{bw} = \frac{F_{pb} \times 10^6}{V}$$

where:

$P_{bw}$ = concentration of lead in air suspended particulate matter during the monitoring period, in µg/m³;

$F_{pb}$ = Net weight of lead in sample filter, in g; and

$10^6$ = Conversion of g to µg.

### 5.10 INTERPRETATION OF SAMPLE RESULTS

**5.10.1** As required in EPA 40 CFR 50.12, the concentration of airborne lead in suspended particulate matter cannot exceed 1.5 micrograms per cubic meter (µg/m³), maximum arithmetic mean, averaged over a calendar quarter.

**5.10.2** One method of interpretation is to state that the calculated mass concentration of lead in air suspended particulate matter based on a twenty four hour time weighted average may not exceed the Daily Allowance (DA) as calculated below:

$$DA = \frac{90}{PD} \times 1.5$$

where:

DA = Daily Allowance, in µg/m³;

PD = duration of contractor work in a 90 day period (days)

**5.10.3** The above calculation provides allowance criteria for a 24 period. In order to convert this value to an allowable daily amount corresponding to the hours worked, use the following formula:

$$ADA = DA \times \frac{24}{H}$$

where:

H = Hours worked in 24 hours

ADA = Adjusted Daily Allowance

It should be noted for short duration projects (e.g., less than 30 surface preparation days), the ADA may be too high to be adequately protective. The specifiers may want to select a more conservative DA or ADA. For example, the Allegheny County Health Department (Pittsburgh, PA) uses 10 µg/m³ as an ADA regardless of the duration of the project.

**5.10.4** The ADA calculation is intended for use as a guideline to monitor compliance with the NAAQS during a project. Therefore, PD should be established at the start of a project using the contractor's anticipated work schedule. At the end of each 24-hour period, the ADA can be calculated using this assumed PD and the actual hours worked during that period.

**5.10.5** After project completion, or after the end of each 90-day period, the average calculated mass concentration of lead in air suspended particulate matter over the previous 90 days should not exceed the Adjusted Quarterly Average Allowance (AQAA) as calculated below. This compliance test could be performed every day of the project from the 90th day forward, comparing the average actual TSP results for the previous 90 days with the AQAA for the same period.

$$AQAA = \frac{2160}{H} \times 1.5\ \mu g/m^3$$

where:

H = Number of actual hours of emission generating activities during the previous 90 days

2160 = Total number of hours in 90 days

### 5.11 FLOW RATE CALIBRATION

**5.11.1** Calibrate the flow rate against a primary flow or volume standard traceable to the National Bureau of Standards (NBS) as described in 40 CFR 50 Appendix B, Item 9.0.

Provided by : www.spic.ir Licensee: NISOC Library

**5.11.2** Calibrate each sampler (whether volumetric or mass flow controller) in accordance with the manufacturer's instructions and as follows:

1. Following installation;
2. Following sampler maintenance;
3. Following relocation of sampler;
4. No less than quarterly or every 360 sampling hours (whichever comes first).

**5.12 RECORDKEEPING**

At a minimum, the following information should be recorded:

1. Name and location of jobsite.
2. Date of monitoring.
3. Monitoring duration (i.e., time monitoring begins and ends each day) and daily logs of air monitoring events.
4. Duration and location of emission-generating operations.
5. Type of emission-generating activities conducted (i.e., blasting, cleaning, blowdown, painting, etc.)
6. Identification and serial number of monitoring units.
7. Description of specific monitor locations.
8. Wind direction and velocity.
9. Air temperature.
10. A flow chart verifying the rate of air flow across the filter throughout the sampling period.
11. Name and address of laboratory used.
12. Laboratory sample field data sheets and chain of custody results.
13. Laboratory test procedure utilized.
14. Ambient and background TSP-Lead concentration, expressed in $\mu g/m^3$; include calculations for DA, ADA, and/or AQAA.
15. Names and initials of person/firm conducting the work.

## 6. Area or Perimeter Air Monitoring

**6.1 DESCRIPTION OF METHOD**

**6.1.1** This method provides a means for assessing the adequacy of the regulated areas or zones around work activities which might emit lead. This method is designed to assess whether adjacent workers are exposed to airborne lead concentrations in excess of the Action Level. This method is not equivalent to, nor an acceptable replacement for, ambient air monitoring for TSP-lead, or PM-10.

**6.1.2** Activities that might generate airborne lead emissions and for which area or perimeter air monitoring may be performed include, but are not limited to, paint removal activities, dust collection systems, abrasive reclamation or handling areas, and debris containerizing areas.

**6.1.3** A minimum of 48 hours is typically required before receiving laboratory test results.

**6.2 MATERIALS AND EQUIPMENT**

**6.2.1** Low flow personal pumps which operate from 1 to 5 liters per minute or high flow pumps which operate from 10 to 15 liters per minute.

**6.2.2** Supply of 37 mm mixed cellulose ester filter cassettes. A new cassette is required for each pump for each shift of operation.

**6.2.3** Rechargeable batteries with charger or a supply of household current (if high flow AC pumps are used).

**6.3 PROCEDURE**

**6.3.1** Position low flow or high flow pumps at the perimeter of the zone at upwind and downwind locations at a minimum. Maintain the filter cassette at breathing zone height.

**6.3.2** Use the equipment in strict accordance with the manufacturer's instructions. Calibrate the pumps at a flow rate between 10 to 15 liters of air per minute (for the high flow pumps) or at a flow rate between 2 to 4 liters of air per minute for the low flow pumps using a primary or secondary standard.

**6.3.3** The monitoring equipment must be calibrated before each day of sampling with the pump status and flow rate checked a minimum of once every four hours, and upon completion of sampling at the end of the period.

**6.3.4** Collect the area samples during representative operations throughout an entire work shift and provide results as an 8 hour time weighted average. Note that high-flow units may be operated for shorter durations.

**6.3.5** Cap the filter cassettes immediately upon removal, and send to the laboratory along with a field blank (cassette exposed to the same environment, but not attached to a sampling pump). A chain of custody form should be included with each shipment to the laboratory.

**6.3.6** Request that the cassettes be analyzed for lead in accordance with NIOSH Method 7082 or equivalent (and for any other metal of concern such as arsenic, chromium or cadmium).

**6.3.7** Once the zone is established, monitoring need not be repeated for that work activity or operation unless work practices change or suspect visible emissions are observed. In this case, monitoring must be conducted to reconfirm or reestablish the regulated area.

**6.4 LABORATORY ANALYSIS:** All air samples should be analyzed according to NIOSH Method 7082 or equivalent, by an American Industrial Hygiene Association (AIHA) laboratory accredited in metals analysis.

**6.5 REPORTING/RECORDKEEPING**

**6.5.1** The following information should be reported at a minimum.

1. Name and location of job site.
2. Date of monitoring.

Provided by : www.spic.ir Licensee: NISOC Library

3. Identification and serial number of sampling pumps.

4. Duration of monitoring (time monitoring begins and ends.

5. Sampling flow rate.

6. Location of sampling pumps.

7. Description and location of the operations underway that the sampling represents.

8. Laboratory sample field data sheets and chain of custody records.

9. Name and address of laboratory used.

10. Laboratory analytical method used.

11. Laboratory test results expressed as an 8 hour time weighted average.

12. Name of person/firm conducting the work.

## 7. PM-10 Monitoring

**7.1 DESCRIPTION OF METHOD:** PM-10 concentration is defined by EPA as particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM-10) in ambient air over a 24 hour period for purposes of determining compliance with the ambient air concentrations as prescribed in the Primary and Secondary National Ambient Air Quality Standards (NAAQS) for particulate matter. This method is also used as a quantitative means of documenting the effectiveness of the surface preparation operation containment system and verifying that the public is not being impacted by the surface preparation operations. **Reminder**: *SSPC does not recommend the use of PM-10 to evaluate lead emissions, because recent research has found that the TSP method provides more accurate data.*

### 7.2 MATERIALS AND EQUIPMENT

**7.2.1** The following equipment is commonly used:

1. High volume air samplers designed in accordance with 40 CFR 50, Appendix B, Item 7, that are capable of drawing ambient air at a constant flow rate of between 39 cubic feet per minute (or 4 cubic meters per minute) and 60 CFM (10 CMM) for a 24 hour period through a glass fiber filter at a uniform face velocity.
2. Slack tube (water column monitor).
3. A whirling hygrometer (sling psychrometer).
4. Altimeter (barometer).
5. A wind velocity and direction indicator.
6. Sampler calibration kit.
7. An electrical source of sufficient power and duration to operate the specified high volume air samplers for a 24 hour period. It should be noted that the power source must be close enough to the monitors and have sufficient amperage to maintain the required uniform face velocity.
8. At a minimum, twelve (12) gauge extension cords and ground fault circuit interrupters (GFCIs) should be used to maintain necessary amperage and prevent damage to motors during power surges.

**7.2.2** The following materials are required:

1. Glass fiber filters for sample collection.
2. Manila or glassine envelopes.
3. Appropriate sample collection and field data forms.
4. Recorder charts.
5. Clean, dry, powder-free surgical gloves may be worn to prevent contamination of filters when handling them.
6. Silicone release spray (applied in accordance with manufacturer's instructions).

### 7.3 SITING AND NUMBER OF MONITORING STATIONS

**7.3.1** Install sampling stations at locations as shown in Section 5.3.1.

**7.3.2** Do not place samplers near the source of local lead or particulate emissions or under the drip lines of trees.

**7.3.3** Siting of ambient air monitors is typically performed on a case-by-case basis. Additional monitoring guidance can be found in 40 CFR 58, Ambient Air Quality Surveillance, Probe Siting Criteria. These criteria provide guidance for placing ambient monitors on fixed sites.

**7.3.4** Further guidance for placement on industrial painting projects can be found in *Project Design, Industrial Lead Paint Removal Handbook, Volume II* (SSPC 95-06).

### 7.4 PROCEDURE

**7.4.1** Operate the sampler in accordance with the manufacturer's instructions.

**7.4.2** Calibrate the sampler in accordance with manufacturer's instructions and Section 7.11.

**7.4.3** Sample filters shall be inspected and approved by the certified laboratory and equilibrated at a constant temperature and pressure environment for a minimum of 24 hours prior to weighing. Pre-weigh sample filter using an analytical balance with a sensitivity of at least 0.1 mg.

**7.4.4** Establish a filter information record and assign an identification number to each filter prior to weighing.

**7.4.5** Prior to installation in sampler, inspect sample filter for tears, pinholes, particles, and other irregularities and discard the sample filter if a defect is found.

**7.4.6** Install a preweighed numbered filter in the sampler as directed by the sampler manufacturer.

**7.4.7** Turn on the sampler and wait a minimum of five minutes until the flow rate is stabilized. Record site information (field technician, date, site location, sampler location, ambient temperature, barometric pressure, wind speed, wind direction, general weather conditions).

**7.4.8** Determine sampler flow rate from the flow recorder or for volumetric flow controlled samplers by using the water manometer readings and the lookup table specific to that monitor, in actual cubic meters per minute (CMM) or cubic feet per minute (CFM), in accordance with sampler manufacturer's instructions.

**7.4.9** Record sample information (start time, sample

Provided by : www.spic.ir Licensee: NISOC Library

**7.4.10** Sample for duration as specified in Section 7.6.

**7.4.11** Calculate and record average flow rate (Q) in actual CMM for the sampling period in accordance with sampler manufacturer's instructions. Record the sample end time and site information (ambient temperature, barometric pressure, wind speed, wind direction, and general weather conditions). Note any unusual activity (construction, fires, etc.) that might affect the concentration of PM-10 at the site.

**7.4.12** Remove the filter from the sampler, taking care to avoid contaminating the filter. When handling the filter, grasp the outer edge to avoid disturbance of particulate deposits. Do not stack or otherwise allow the filters to make contact with one another.

**7.4.13** Fold exposed sample filter lengthwise with the top (or exposed) side facing inward and place into a separate sealed glassine or manila envelope.

**7.4.14** Transmit the exposed sample filter, sample data sheet, and completed chain of custody form to the laboratory for equilibration and weighing. If volume is being calculated by the laboratory, send flow recorder chart.

### 7.5 BACKGROUND MONITORING

**7.5.1** Frequently background monitoring is conducted to determine the preexisting emissions levels at the site. Background monitoring will often identify other sources of lead or dust emissions (such as traffic or industrial pollutants). Background sampling is typically conducted for one to five days depending upon the projected duration of monitoring.

**7.5.2** Conduct background monitoring as follows to determine the contribution of other sources to the concentration of lead in air in the monitoring zone.

1. Immediately prior to surface preparation activities, install samplers as described in Section 5.3 and collect samples.
2. Use background results to assist in the interpretation of the project monitoring results.

### 7.6 OFF-HOURS MONITORING

**7.6.1** Ambient air monitoring for PM-10 on industrial lead paint removal operations is often conducted for sampling durations less than the 24 hour periods regulated by the NAAQS, usually only during that part of the day when work activities on a job site may create dust emissions. To compare the measurements obtained during that sampling period to the 24-hour limits, an estimate may be collected which represents the portion of the day during which time monitoring (and presumably work activities) did not occur.

While background levels of PM-10 determined prior to mobilization of site equipment may represent this off-hours period under certain conditions, and has been widely used in the past to represent this portion of the day, idle equipment and contaminated job site materials may provide some minor sources of emission during these off-hours periods. Therefore, background levels recorded prior to site mobilization may be inappropriate to represent the unsampled portion of the 24 hour day.

**7.6.2** Conduct off-hour monitoring for eight hours (or equivalent to work duration) at the beginning of a project and consider additional measurements (once a month) thereafter for longer projects. Conduct off-hours monitoring during any nonproduction time period which represents typical off-hours conditions.

**7.6.3** Use the average of several days of off-hours ambient air monitoring in the computation of project monitoring results (Adjusted Daily Average [ADA]).

### 7.7 DURATION OF MONITORING

**7.7.1** Monitoring is typically conducted during project activities or for a full twenty-four (24) hour duration. Contact local authorities to determine any monitoring duration requirements.

**7.7.2** For monitoring project activities, collect samples beginning at least one half-hour prior to emission-generating activities and continuing for a minimum of one half-hour after emission-generating activities have ended, including cleanup activities and moving or dismantling the containment.

**7.7.3** Cease sample collection only after all surface preparation operations have ceased and the surface preparation contractor has demobilized from the site.

### 7.8 QUALITY CONTROL AND CHAIN OF CUSTODY

**7.8.1** Maintain quality assurance procedures as described in EPA 40 CFR 58, Appendices A and B, and EP/600(R-94/0388), Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. II, Ambient Air Specific Methods, Sections 2.8 (Lead) and 2.11 (PM-10).

### 7.9 ANALYSIS OF SAMPLES

**7.9.1** Sample analysis should be performed by a laboratory approved by the owner. Laboratories performing analysis should be familiar with ambient air monitoring. Very few accreditations for PM-10 exist. Those available include the NYELAP (New York Environmental Laboratory Accreditation Program) and the National Performance Audit Program administered by Mantech and Environmental Technology, Inc. for the EPA. Accreditations that are similar include accreditation by the American Industrial Hygiene Association (AIHA) for metals in its Industrial Hygiene (IH) program.

**7.9.2** The following analysis should be performed in accordance with 40 CFR 50, Appendix J to determine the net weight (mass) gain due to collected PM-10 in each sample filter.

1. Equilibrate each filter in a conditioning environment (temperature 15 to 30 °C ± 3 °C [59 to 86 °F ± 5 °F], humidity 20% to 45% RH ± 5% RH) for at least 24 hours.

Provided by : www.spic.ir Licensee: NISOC Library

2. Following equilibration, weigh each sample filter and record the presampling weight with the filter identification number.

3. Install filter in sampler and collect sample as described in Section 7.5. The volume of air sampled shall be corrected to EPA reference conditions (25 °C, 101.3 kPa [77 °F, 14.7 psi]) determined from the measured flow rate and the sampling time.

4. Equilibrate the exposed filter in the conditioning environment for at least 24 hours under the same temperature and humidity conditions.

5. Immediately after equilibration, weigh the filter and record the post-sampling weight with the filter identification number.

**7.9.3** The mass concentration of PM-10 shall be computed as the total mass of collected particles in the PM-10 size range divided by the volume of air sampled, and is expressed in micrograms per standard cubic meter.

1. Determine the initial and final flow rates from the continuous flow recorder or the sampler calibration curve. The calculated average flow rate, $Q_a$, is one half the sum of the initial and final flow rates.

2. Correct $Q_a$ to $Q_{std}$ where:

$$Q_{std} = Q_a \times \frac{P_a}{P_{std}} \times \frac{T_{std}}{T_a}$$

$Q_a$ = average flow rate

$P_a$ = actual pressure x mm Hg

$P_{std}$ = 760 mm Hg

$T_a$ = actual temperature

$T_{std}$ = 290 K

3. The total air volume sampled is calculated as

$$V = Q_{std} \times t$$

where:

V = Total air volume sampled, in CMM;

$Q_{std}$ = Average standard flow rate, in CMM; and

t = sampling time, in minutes

### 7.10 INTERPRETATION OF RESULTS

**7.10.1** As required in EPA 40 CFR 50.6, concentration of PM-10 shall not exceed 150 micrograms per cubic meter ($\mu g/m^3$) in any 24-hour average period.

**7.10.2** If the project does not operate continuously for each 24-hour period, the concentration of PM-10 shall not exceed the Adjusted Daily Allowance (ADA) for PM-10 as calculated below:

$$ADA = DA \times \frac{24}{H} \times 150\ \mu g/m^3$$

Where:

H = number of actual hours of blasting activities out of 24 hours

### 7.11 FLOW RATE CALIBRATION

**7.11.1** Calibrate the flow rate against a primary flow or volume standard traceable to the National Institute of Standards and Technology (NIST) as described in 40 CFR 50 Appendix J, Item 8.2 and the sampler manufacturer's instructions.

**7.11.2** Calibrate each sampler (whether volumetric or mass flow controller) in accordance with the manufacturer's instructions and as follows:

1. Following installation;
2. Following sampler maintenance;
3. Following relocation of sampler;
4. No less than quarterly or every 360 sampling hours (whichever comes first).

### 7.12 REPORTS/RECORDKEEPING

At a minimum, the following information should be recorded:

1. Name and location of jobsite.
2. Date of monitoring.
3. Monitoring duration (i.e., time monitoring begins and ends each day), and daily logs of air monitoring events.
4. Duration and location of emission-generating operations.
5. Type of emission-generating activities conducted (i.e., blasting, blowdown, painting, etc.).
6. Identification and serial number of monitoring units.
7. Description of specific monitor locations.
8. Wind direction and velocity.
9. Temperature.
10. A flow chart verifying the rate of air flow across the filter throughout the sampling period.
11. Name and address of laboratory used.
12. Laboratory sample field data sheets and chain of custody results.
13. Laboratory test procedure utilized.
14. Ambient and background TSP-Lead concentration, expressed in $\mu g/m^3$. Include calculations for DA, ADA, and/or AQAA.
15. Names and initials of person/firm conducting the work.

### 7.13 SSPC PM-10 POSITION PAPER

In 1998, SSPC issued a position paper regarding PM-10 monitoring on industrial paint removal projects. The position paper stated that based on the past 10 years of monitoring both PM-10 and TSP-lead in the industrial painting industry, little or no additional information appeared to be gained from the PM-10 monitoring. As monitoring of industrial paint removal projects is typically performed to verify the adequacy of the controls and that the public has

Provided by : www.spic.ir Licensee: NISOC Library

not been impacted, rather than strict compliance with the NAAQS, it is believed that PM-10 monitoring provides little additional information. A complete copy of the PM-10 position paper is attached as an Appendix to this Technology Update. (For further information, refer to the article "Evaluation of Ambient Air Quality Monitoring Procedures Outside of Containment", by John Zamurs and Jonathan Bass, *Journal of Protective Coatings & Linings*, 14, 10, pp. 65-77 [Oct. 1998]).

## 8. Visible Emissions Evaluation Using Method 22 (40 CFR 60, Appendix A)

### 8.1 DESCRIPTION OF METHOD

**8.1.1** This method provides a means for quickly detecting potential pollution-causing events through the use of visible emissions by a knowledgeable observer.

**8.1.2** Visible emissions assessments allow immediate containment or work practice changes to be made without waiting days for the results of laboratory analysis. This method is a suitable supplement to instrument monitoring methods, but in the event of a conflict, the instrument data typically prevails. Visible emissions assessments are more useful for project shutdown to avoid a pollution event, rather than for acceptance purposes.

**8.1.3** The method is based on 40 CFR 60, Appendix A, Method 22, which assesses total emissions.

**8.1.4** SSPC-Guide 6 provides five classifications of visible emissions as follows:

a. Level 0 Emissions: No visible emissions. (It should be noted that Level 0 emissions should not be considered for abrasive blasting projects since this level is typically not achievable during abrasive blasting.)

b. Level 1 Emissions: Random emissions of a cumulative duration of no more than 1% of the work day. This amounts to a duration of 5 minutes in an 8 hour work day. This might also be adjusted to an hourly rate such as no more than 36 seconds per hour, or 9 seconds per 15 minute observation period.

c. Level 2 Emissions: Random emissions of a cumulative duration of no more than 5% of the work day. This amounts to a duration of 24 minutes in an 8-hour work day. This might also be adjusted to an hourly rate such as no more than 3 minutes per hour, or 45 seconds per 15 minute observation period.

d. Level 3 Emissions: Random emissions of a cumulative duration of no more than 10% of the work day. This amounts to a duration of 48 minutes in an 8-hour work day. This might also be adjusted to an hourly rate of 6 minutes per hour or 90 seconds per 15 minute observation period.

e. Level 4 Emissions: Emissions are unrestricted and may occur at any time.

**8.1.5** Establish the allowable level of emissions which is typically Level 0 or Level 1. When interpreting visible emissions data, recognize that violations of any of the other methods of monitoring (e.g., TSP lead) will prevail even if the visible emissions assessments are in compliance.

**8.2 MATERIALS AND EQUIPMENT:** A wristwatch, a stop watch (i.e., two watches) and a site plot plan are needed for visual emissions assessment.

### 8.3 OBSERVATION LOCATIONS

**8.3.1** The observer should stand at a distance that provides a clear view of the emissions with the sun generally oriented to the observer's back.

**8.3.2** The observer should view emissions approximately perpendicular to the angle of the emissions.

**8.3.3** The observer should view emissions against a background of contrasting color.

### 8.4 EMISSION EVALUATION PROCEDURES

**8.4.1** Fugitive emissions from all project activities are assessed. This includes the paint removal activities, dust collection systems, abrasive reclamation or handling areas, and debris containerizing operations.

**8.4.2** The observer measures and records the length of time that emissions are observed from the containment and equipment.

**8.4.3** Establish if unacceptable emissions are those which escape the containment, pass beyond a certain boundary such as the regulated area or property line, or some other criteria.

### 8.5 DURATION OF EMISSION EVALUATIONS

**8.5.1** An observation time no longer than 15 to 20 minutes is selected, and all sources of emissions are observed for the entire time. The stop watch is started and stopped each time emissions are visible.

**8.5.2** For every 15 to 20 minutes of observation time, a rest break of 10 to 15 minutes is suggested.

**8.5.3** The accumulated time of all visible emissions within each observation period is reported.

### 8.6 QA/QC - REPORTING

**8.6.1** The following information should be recorded at a minimum:

1. Name and location of jobsite.
2. Date of evaluation.
3. Weather conditions
4. Name of observer.
5. Location of observer.
6. Activities underway at the time of observation.
7. Items observed.
8. Observation start and stop times.
9. Descriptions of emissions observed.

**8.6.2** Documentation should include a description of each time work activities are halted due to unacceptable visible emissions and the corrective action taken to correct the deficiency.

Provided by : www.spic.ir Licensee: NISOC Library

## 9. Visible Emission Evaluation Using Method 9 (40 CFR 60, Appendix A)

### 9.1 DESCRIPTION OF METHOD

**9.1.1** This method provides procedures for certifying and training observers, conducting observations, and interpreting results. It provides a means for quickly detecting potential pollution-causing events through the observation of visible emissions.

**9.1.2** An opacity scale ranging from 5% to 100% in 5-percent increments is used. Opacity is defined by the degree to which the transmission of light is reduced or as the degree to which the visibility of a background as viewed through the plume is reduced.

**9.1.3** To conduct opacity assessments in accordance with Method 9, the emission evaluator must be certified at least twice yearly. (The certification is valid for six months.)

**9.1.4** This method is generally used only to comply with state and local air quality opacity regulations.

### 9.2 MATERIALS AND EQUIPMENT

1. Stop Watch
2. Compass
3. Air Velocity Meter
4. Range Finder
5. Site Plot Plan

### 9.3 OBSERVATION LOCATIONS

**9.3.1** The observer should stand at a distance that provides a clear view of the emissions.

**9.3.2** The sun should be oriented within 140 degree sector to the observer's back.

**9.3.3** The observer should view emissions approximately perpendicular to the angle of the emissions.

**9.3.4** The observer should view emissions against a background of contrasting color.

**9.3.5** Establish a viewing distance somewhere between the height of the emissions and no more than two times the height of the point of emission.

### 9.4 EMISSION EVALUATION PROCEDURES

**9.4.1** Fugitive emissions from all project activities are assessed. This includes the paint removal activities, dust collection systems, abrasive reclamation or handling areas, and debris containerizing operations.

**9.4.2** The observer reads the opacity at 15-second intervals, viewing only momentarily then looking away. Each reading is reported to the nearest 5 percent opacity with a minimum of 24 observations being recorded per observation period (6 minutes).

**9.4.3** Most states establish limiting criteria such as no more than 20% opacity for three (3) minutes or no more than 60% opacity at any time.

**9.4.4** Check with state and local air quality agencies to determine emission criteria and to establish if unacceptable emissions are those which escape the containment, pass beyond a certain boundary such as the regulated area or property line, or some other criteria.

### 9.5 DURATION OF EMISSION EVALUATIONS

**9.5.1** An observation time of at least six (6) minutes and no longer than 60 minutes is selected.

**9.5.2** One source of emissions is observed at a time.

### 9.6 QA/QC - REPORTING

**9.6.1** The following information should be recorded at a minimum:

1. Name and location of jobsite.
2. Date of evaluation.
3. Weather conditions.
4. Name of observer.
5. Location of observer.
6. Activities underway at the time of observation.
7. Items observed.
8. Observation start and stop times.
9. Opacities observed.
10. Descriptions of emissions observed.
11. Certificate number of observer.

**9.6.2** Documentation should include a description of each time work activities are halted due to unacceptable visible emissions and the corrective action taken to correct the deficiency.

## 10. Ground (Soil) Sampling and Analysis

### 10.1 DESCRIPTION OF METHOD

**10.1.1** This method provides procedures for the controlled sampling and analysis of ground (soil) prior to project start-up and upon completion in order to assess the effectiveness of the controls over of emissions, and to determine if the ground was contaminated from project activities. This method is used for the evaluation of surface lead only to determine the impact of paint removal projects. It is not suitable for site characterization purposes.

**10.1.2** It must be recognized that preexisting levels of lead in the ground can vary greatly within a few feet from past usage of the property, and due to the erratic distribution of previously dislodged paint chips.

**10.1.3** Note that this method relies on an analysis of total lead in pre-job and post job samples to determine if contamination from the paint removal project has occurred. This has no bearing on whether the soil presents an environmental hazard or is a hazardous waste requiring removal and disposal.

### 10.2 MATERIALS AND EQUIPMENT

Materials required include:

1. Sampling tool for the collection of ground plugs

Provided by : www.spic.ir Licensee: NISOC Library

approximately 3/4" (2 cm) in diameter and 1/2" (1 cm) in depth.

2. Sample collection containers comprised of a material such as polyethylene that will not contaminate the sample.

3. Tape measure and compass for documenting the locations of the samples.

4. Sampling template measuring 12" x 12" (30 cm x 30 cm) in size with a 1" (2.5 cm) hole in the center.

5. Supply of deionized water and/or nitric acid for cleaning the sampling equipment.

### 10.3 SAMPLE SITE SELECTION

**10.3.1** Soil sampling site selection is typically performed on a case-by-case basis based on the location of the structure and other site-specific characteristics.

**10.3.2** Guidance for selection of soil sample sites for industrial painting project can be found in Project Design, *Industrial Lead Paint Removal Handbook, Volume II* (SSPC 95-06).

### 10.4 PROCEDURE FOR TAKING SOIL SAMPLES

1. Measure and document the precise location of each sample site.

2. At each sample site, remove samples of the surface of the ground (soil) as described below.

3. At each sample location, remove visible chips of paint on the surface of the ground by hand. (Chips must always be cleaned upon project completion. The purpose of this sampling and analysis is to determine if “non-visible” contamination has occurred.)

4. Place a 12" x 12" (30 cm x 30 cm) template parallel or tangential to the structure.

5. Remove surface plugs of ground each measuring approximately 3/4" (2 cm) in diameter and 1/2" (1 cm) from the center of the template and at each of the four corners. Care must be taken not to collect vegetation such as grass in the sample plug. Place the five plugs into a single sample container. This represents one sample from the test location. Clean the sampling tool with deionized water prior to moving to a new sample site.

6. Move the template approximately 3 inches (8 cm) further away from the structure and remove a duplicate sample (5 plugs total) . Place it into a separate container. This completes the sampling at the selected test location.

### 10.5 FREQUENCY OF SAMPLING

1. Remove samples prior to project start-up and again upon project completion at the same location.

2. Interim samples may also be taken on multi-year projects, or to measure the performance of the containment during the course of the project, or to determine the impact of any spills.

### 10.6 REPORTING/RECORDKEEPING

**10.6.1** Control sample as follows:

1. On each container, record a unique sample number, sample location, date of sampling, and the name of the technician responsible for removing the sample.

2. Complete a chain of custody form to accompany the sample from the point of collection to the laboratory.

**10.6.2** Complete the following documentation at a minimum:

1. Name and location of jobsite.
2. Dates of sampling.
3. Visual evidence of contamination.
4. Specific location of sample sites (direction and distance). The use of drawings is advised.
5. Laboratory sample field data sheets and chain of custody records.
6. Name and address of laboratory used.
7. Laboratory test procedure utilized.
8. Laboratory test results, expressed in ppm.
9. Name of person/firm conducting the sampling.

**10.7 Laboratory Analysis:** Preparation of the samples for analysis shall be in accordance with EPA Method 3050 or approved equivalent. Samples can be analyzed for other metals, however increased lead level is generally a sufficient indication of contamination. If the analysis includes other elements, the test method(s) should be provided. Laboratory analysis should be performed by a laboratory participating in the Environmental Lead Laboratory Accreditation Program (ELLAP)

**10.8 Interpretation:** Results can be interpreted through a variety of techniques as there are no Federal regulations directly applicable to soil sampling on industrial paint removal projects. Pre- and post-project samples can be compared by:

1. Direct comparison of post-sample to pre-sample for an increase of total lead content.

2. Comparison of geometric means between pre- and post-project sample sets.

3. Use of the paired Student T- test. Increases beyond the 95 percent confidence level would indicate contamination.

4. Comparison to the levels established by the EPA Recommendations for Response Activities for Residential Lead-Contaminated Bare Soil.

## 11. Method for Water/Sediment Sampling

### 11.1 DESCRIPTION OF METHOD

**11.1.1** This method provides procedures for the controlled sampling and analysis of water and sediment prior to job start up and upon completion in order to assess the effectiveness of the containment of emissions, and to determine if the water/sediment was adversely impacted from project activities. This method does not determine the need or magnitude of any remediation that might be required. It is not suitable for site characterization purposes.

Provided by : www.spic.ir Licensee: NISOC Library

**11.1.2** Pollution of the water or sediment from lead paint removal activities is prohibited by the Clean Water Act (CWA). The sampling of surface water and sediment for lead to confirm that pollution has not occurred is of value only in limited circumstances. In fast moving bodies of water, water sampling represents only transient water quality and proper evaluation of results is difficult. Likewise, for deep bodies of water (e.g., greater than 18 feet [6 meters] in depth), sediment sampling may not detect the incidental lead releases which might occur from properly designed and executed lead paint removal operations. Water or sediment sampling may provide meaningful data for slow moving, shallow bodies of water, at drinking water intakes proximate to the work area, or if sensitive environmental receptors (e.g., wetlands, oyster beds) are near the site.

**11.2 MATERIALS AND EQUIPMENT**

1. Rigid glass or plastic container with resealable lid with approximately 8 ounces (240 ml) in capacity. For water samples, the sampling container should be pretreated with nitric acid to reduce plating of lead to the container.
2. Stainless steel or plastic scoop for collection of sediment samples.
3. Tape measure and compass for documenting the precise sample locations.

**11.3 SAMPLE SITE SELECTION**

**11.3.1** Water and sediment sampling site selection is typically performed on a case-by-case basis based on the location of the structure and other site-specific characteristics.

**11.3.2** Guidance for selection of water and sediment sample sites for industrial painting project can be found in *Project Design, Industrial Lead Paint Removal Handbook, Volume II* (SSPC 95-06).

**11.4 PROCEDURE FOR TAKING WATER SAMPLES**

**11.4.1** Measure and document the precise location of each sample site.

**11.4.2 Collection of Water Samples**

1. Use a dip or grab sampling procedure.
2. Grasp the exterior of the container (do not touch the interior surfaces) and dip into the water with the opening facing in an upstream direction. Wait until all of the air has been displaced and remove the container from the water.
3. Collect approximately 8 oz. (240 ml) of water, seal the container, and tape it shut to avoid spills or tampering.

**11.4.3 Collection of Sediment Samples**

1. Use a scoop sampling procedure.
2. Sample only the top 4" (10 cm) of sediment, scooping in an upstream direction.
3. Collect approximately 8 oz. (240 ml) of sediment, seal the container, and tape it shut to avoid spilling or tampering.

**11.5 FREQUENCY OF SAMPLING**

**11.5.1** At a minimum, remove samples prior to project start-up and again upon project completion at the same locations.

**11.5.2** Interim samples may be taken to track the performance of the containment during the course of the project, or to assess the impact of any spills.

**11.6 REPORTING/RECORDKEEPING**

**11.6.1** Control sample as follows:

1. On each container, record a unique sample number, sample location, date of sampling, and the name of the technician responsible for removing the sample.
2. Complete a chain of custody form to accompany the sample from the point of collection to the laboratory.

**11.6.2** Complete the following documentation at a minimum:

1. Name and location of jobsite.
2. Dates of sampling.
3. Visual evidence of contamination.
4. Specific location of sample sites (direction and distance). The use of drawings is advised.
5. Laboratory sample field data sheets and chain of custody records.
6. Name and address of laboratory used.
7. Laboratory test procedure utilized.
8. Laboratory test results, expressed in ppm.
9. Name of person/firm conducting the sampling.

**11.7 LABORATORY ANALYSIS:** Preparation of the samples for analysis shall be in accordance with EPA Method 3050 or approved equivalent. If the analysis includes other elements, the test method(s) should be provided. Laboratory analysis should be performed by a laboratory participating in the Environmental Lead Laboratory Accreditation Program (ELLAP)

**11.8 INTERPRETATION:** Results can be interpreted through a variety of techniques as there are no Federal regulations directly applicable to sediment and water sampling on industrial paint removal projects. Pre- and post-project samples can be compared by:

1. Direct comparison of post-sample to pre-sample for an increase of total lead content.
2. Comparison of geometric means between pre- and post-project sample sets.
3. Use of the paired Student T-test. Increases beyond the 95 percent confidence level could indicate contamination.

## 12. Disclaimer

This technology update is for information purposes only. It is neither a standard nor a recommended practice. While every precaution is taken to ensure that all information furnished in SSPC technology updates is as accurate,

Provided by : www.spic.ir Licensee: NISOC Library

complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, paints, or methods specified herein, or of the technology update itself.

## Appendix A. Method - Real Time Monitoring

**A.1** This method provides a means for assessing emissions through the use of real-time monitors. It is included as an appendix because there is not yet a federal (e.g., OSHA, NIOSH, or EPA) standard associated with its use. This method is not an acceptable substitute for federal, state, or local mandated high volume ambient monitoring or OSHA/NIOSH approved sampling. The recently issued Final Environmental Impact Statement developed for the New York City Department of Transportation has evaluated this method as semi-quantitative and only recommended for use to assess containment integrity (e.g., seams and entryways).

### A.2 EQUIPMENT SPECIFICATION

**A.2.1 Real-Time Particulate Monitors:** Real-time monitors are available either as active or as passive sampling instruments. For outdoor applications, however, active monitors (i.e., incorporating a pump and flow rate control) are to be preferred because representative sampling under conditions of varying wind speed and direction can only be ensured using aspirated air flow with appropriate inlet configurations. This monitor, in addition to providing the real-time data, also provides time averaged information, a selectable alarm, and the capability of collecting the dust sample for lead analysis.

**A.2.2 Sampling Inlet:** To ensure representative sampling of airborne particulate matter under varying wind conditions an omnidirectional sampling inlet should be used. It can be connected directly to the monitor or mounted separately (e.g., over a roof) using a vertical length of tubing.

**A.2.3 High Humidity Operation:** When operating under conditions of ambient relative humidity higher than approximately 70%, an in-line sample heater should be used to evaporate liquid water accreted by the airborne particles. This water would otherwise result in an increase of the monitor readings.

### A.3 SITING OF MONITORING STATIONS

**A.3.1 Number:** At a minimum, monitors should be located upwind and downwind of the work area. For more complete coverage, two additional monitors at 90° with respect to the prevailing wind direction are recommended.

**A.3.2 Distance:** For area monitoring, the monitors should be located at the outer boundaries of the work site (i.e., fence monitoring) to ensure that the emissions from the site are within acceptable levels. Placement of monitors within the site (i.e., directly at the source of dust) is likely to impose excessively (and unnecessarily) stringent dust concentration constraints, given the fact that some of the airborne dust will have settled out and will have been diluted before it leaves the boundaries of the site.

**A.3.2 Special Cases:** In some situations, when the work site is near residential sections or other sensitive areas, one or more monitors should be located in line between the work site and the sensitive area.

### A.4 GENERAL MONITORING PROCEDURES

**A.4.1 Monitoring Modes:** There are three principal modes to consider:

a) real-time dust concentration readings
b) alarms
c) dust concentration time history

**A.4.1.1 Real-Time Measurements:** These are useful for relating dust emissions to a particular work procedure. This requires observing the readings on the monitor display screen.

**A.4.1.2 Alarms:** These immediately alert users about excessive dust levels. Setting of a specific alarm level depends on: a) alarm mode and b) the maximum acceptable dust concentration. Two selectable types of alarm mode are typically available: instantaneous (either 1-second or 10-second) or STEL-based (15-minute running average). If the instantaneous mode is selected, the selected alarm level should be at least three times higher than the maximum allowable 8-hour level, in order to account for the occurrence of very short duration transient dust level peaks. If the STEL mode is selected, the alarm level can be set very near the maximum allowable 8-hour concentration (e.g., 10% higher).

Monitors incorporate an audible alarm which is sufficient for nearby alerting. If remote or distant alerting is required, a separate large flashing indicator can be connected to the DataRAM alarm output, or a hard wire connection to a remotely located observation post can be used to activate an audible or visual alarm.

**A.4.1.3 Time History:** The time history of the dust concentration levels can be recorded by each of the real-time monitors, for subsequent downloading to a printer or computer for archival documentation purposes.

**A.4.2 Background Monitoring:** The background dust level is the concentration that is measured by the site monitors in the absence of dust generating activity. The dust level contributed by the work activities is measured as the difference between the concentration measured during those activities and the background level. This background level, however, is likely to be variable as meteorological conditions and extraneous dust source conditions vary in time. Therefore, the best measure of the background level is that provided by a monitor located upwind of the work site, and the best measure of the dust level contributed by the activities at the site is the difference between concurrent measurements of downwind and upwind concentrations.

Provided by : www.spic.ir Licensee: NISOC Library

**A.4.3 Duration of Monitoring:** Since both short term and long term measurements are of importance, monitoring should be performed throughout the work shift in order to provide instantaneous as well as time averaged data.

**A.5 QUALITY ASSURANCE/QUALITY CONTROL**

**A.5.1 Operator Training on Use of Monitors:** It is important that the personnel charged with the use and operation of the dust monitoring equipment be thoroughly familiar with the instrumentation. A course should be set up for that purpose on a regularly scheduled basis (e.g., once every six months). Instruction could be provided by equipment manufacturer personnel. This training will address not only the use and operation of the instrumentation but also data format and record keeping.

Each equipment operator will be issued a complete set of instruction manuals, relevant application notes, etc., in order to ensure familiarity with and understanding of the proper use of the equipment, and correct interpretation of the resulting data.

**A.5.2 Record Keeping Plan:** At the start of every work day log in the following information:

- Time and date
- Ambient temperature and humidity
- General meteorological conditions (i.e. rain, fog, snow, high wind, etc.)
- Identification and location of each dust monitor
- Sampling conditions of each dust monitor (i.e., type of inlet if different from standard, potential obstructions, etc.).
- Calibration of each monitor reading and diagnostic checks
- Any changes in the parameter programming of the monitors
- Work conditions and operations
- Site idiosyncrasies

**A.5.3 Calibration of Monitors:** Two types of calibration are relevant to real-time dust monitors:

a) primary calibration against a gravimetric reference.
b) secondary calibration check with internal reference.

**A.5.3.1 Primary Calibration:** The primary calibration consists of comparing the time averaged concentration (TWA), determined by a real-time monitor, to the concentration measured using a collocated reference filter sampler running for the same time period as the real-time monitor. The ratio between the reference measurement and the real-time monitor measurement is used to correct or adjust the real-time monitor calibration. Ideally, this type of primary calibration should be performed under realistic and representative field conditions by sampling the actual dust generated at the work site. The reference filter for the primary gravimetric calibration can be inserted directly into the monitor, downstream of the sensing stage of the instrument, obviating the need for a separate filter sampler. This type of primary calibration is required only at the time of the initial set up of the work site and monitoring system, and subsequently only on a spot check basis, perhaps once mid-way during the project and another time near the end of the project.

The primary calibration requires the use of a high precision balance capable of resolving better than 0.01 milligrams.

**A.5.3.2 Secondary Calibration Checks:** Most real-time dust monitors incorporate means to check their adherence to their primary calibration, typically zero and span checks. These secondary calibration checks should be performed routinely at the start of every shift. The zero and span check readings should be noted (documented as mentioned in Section A.5.2).

The internal secondary calibration check is performed by following a two-step sequence: a) monitor zeroing by pressing one key, and b) span checking by pressing another key followed by rotation of a knob that inserts a reference scattering element into the sensing stage, followed in turn by the retraction of that element.

## Appendix B. SSPC Position Statement on High Volume Air Monitoring for PM-10 and TSP During Lead Paint Removal Projects

**Scope:**This position statement defines conditions for reducing or eliminating the use of PM-10 high volume air monitors on lead paint removal projects.

**Summary:** The use of PM-10 high volume air monitoring is not required or recommended for the vast majority of lead paint removal projects.

**NEED FOR CONTAINMENT**

Over the past decade or so, there has been an increased awareness of the need to contain and control emissions from lead paint removal projects. Various types of enclosures are routinely used to contain abrasive blast cleaning and other paint removal operations.

**LEAD AND RESPIRABLE DUST PARTICLES PRODUCED DURING LEAD PAINT REMOVAL**

Abrasive blast cleaning (and some other paint removal methods, such as power tool cleaning) may produce measurable quantities of lead dust and respirable dust particles (less than or equal to 10 micrometers in aerodynamic equivalent diameter). Both of these types of airborne materials are designated as air toxins and have been regulated by EPA as part of the 1970 Clean Air Act (CAA). Under the CAA, the levels of these air particulates are measured using high volume air monitors. These monitors are operated in accordance to EPA reference methods. The air monitor, properly located at a measurement site, draws a measured quantity of ambient air into a covered housing and through a filter during the sampling period. Sampling is

Provided by : www.spic.ir Licensee: NISOC Library

conducted at National or State Air Monitoring Stations (NAMS/SLAMS). The monitors are placed in locations designated by the local air quality regulators to characterize the general quality of air in a large geographic area. On lead paint removal projects, however, the monitors are typically located proximate to the lead paint removal activity or the nearest sensitive (i.e., public) receptors.

For lead, the samplers collect total suspended particulates (TSP), which are then analyzed for lead content (expressed as TSP-lead). The National Ambient Air Quality Standards (NAAQS) allow a maximum of 1.5 $\mu g/m^3$ of lead per day averaged over a 90 day period. For the respirable particles or particulate matter smaller than 10 micrometers equivalent aerodynamic diameter (designated as PM-10), a size selective inlet is used to capture only those particles with a diameter of 10 micrometers or less. The filter is weighed prior to being placed in the sampler, and then weighed following monitor operation to determine the concentration. The maximum permitted concentration of PM-10 is 150 $\mu g/m^3$ for a 24 hour period.

**HIGH VOLUME AIR SAMPLERS TO ASSESS CONTAINMENT**

High volume samplers have also been used to measure the amount of lead and PM-10 released into the environment during abrasive blasting. SSPC-Guide 6, first issued in 1992, identifies several means for determining the efficiency of the containment (i.e, the control of emissions). Methods B and C of Section 5.5 of the guide describe ambient air monitoring for PM-10 and TSP lead, respectively. The same levels as those specified by EPA for the NAAQS are cited. However, it should be noted that air monitoring of a lead paint removal project is not undertaken to determine conformance with the Clean Air Act. It is performed to confirm that the public is not exposed to unregulated emissions. The NAAQS are utilized as benchmark acceptance criteria only. The equipment criteria and laboratory procedures are stipulated because they are standardized and recognized.

**INDUSTRY EXPERIENCE WITH PM-10 AND TSP MONITORING**

In the last ten years, SSPC members and industry have collected and analyzed high volume samples from numerous projects and sites. Several concerns have arisen, including the number of monitors necessary, their placement,and the number of days monitoring should be conducted. This also calls into question the cost-effectiveness of monitoring when considering the value of the data collected in assessing containment effectiveness and public protection.

**TSP-LEAD MORE USEFUL THAN PM-10**

In particular, users have questioned the need for monitoring both PM-10 and TSP-lead. Results indicate that abrasive blasting is much more likely to exceed the TSP levels (1.5 $\mu g/m^3$) than the PM-10 levels (150 $\mu g/m^3$), and that the lead emissions are more directly attributed to the paint removal operation. Moreover, the major concern is preventing contamination of the environment with lead dust and particulates. A recent study by New York State DOT has provided more conclusive evidence that TSP is a more useful parameter than PM-10 (see Addendum A).

**PM-10 NOT RECOMMENDED FOR MONITORING LEAD PAINT REMOVAL PROJECTS**

The SSPC Task Group on Environmental Monitoring recommends that if ambient air monitoring is required that only TSP- lead (and not PM-10) be specified. As discussed above, TSP-lead monitoring is a more sensitive indicator of airborne emissions and also is a better method of detecting the primary toxic of concern (i.e., lead). Additionally, data trends for TSP-lead (i.e., increases in ambient levels) are typically indicative of rises in PM-10 levels. However the converse is not true. PM-10 levels can provide little quantifiable information on TSP-lead levels. As such, the use of PM-10 (in addition to TSP-lead) is considered to add very little additional information regarding emission control and public exposure while adding significant expense to the project.

## Addendum A

**SUMMARY OF NEW YORK STATE DOT MONITORING DATA**

The work was reported by John Zamurs and Jonathan Bass in draft report of June 5, 1995.

The researchers monitored emissions on 20 separate bridge containments in 1993 and 1994. For each project, blast cleaning was conducted for 2 to 12 days, typically 7 to 10 hours per day. The lead content of the paint ranged from 7 to 25% lead by weight, except for one structure with 0.23% lead. The sites were monitored for four types of air particulates: total suspended particulate (all substances), TSP-lead, PM-10 (all substances) and PM-10 lead. The present analysis only deals with the TSP-lead and PM-10 data (eleven of these are shown in Table 1). By far, the greater exceedances occurred for TSP-lead with 41 exceedances versus 2 exceedances for PM-10. In addition, both PM-10 exceedances occurred on days which also had TSP-lead exceedance. This suggests that additional PM-10 data is redundant regarding evaluation of the efficiency of containment or public protection. However, the authors caution against direct comparison of PM-10 and TSP-lead, as they are intended to measure different quantities.

The report concluded "lead is the more sensitive analyte in association with the environmental impact of this type of work (lead paint removal)", and future monitoring should be limited to TSP/TSP-lead with the elimination of PM-10 monitoring. In a follow-up report issued in June 1996, the authors concluded that "monitoring for TSP/TSP-lead has proven sufficient to measure atmospheric loading of dust and lead particulates for this type of work."

Provided by : www.spic.ir Licensee: NISOC Library

**TABLE 1**

**SUMMARY OF MONITORING DATA**

| Project* | Number PM-10 Exceeded | Number TSP-Lead Exceeded | Blasting Duration | Structure Type | % Lead in Paint |
|---|---|---|---|---|---|
| Gowanus | 0 | 0 | 9.9 hrs | Girder | 7.0 |
| Wallkill | 0 | 1 | 7.8 hrs | Truss | 7.0 |
| Queensboro Sections A-D | 0 | 9 | 8.7 hrs | Truss | 9.2 |
| Queensboro Sections E-H | 1 | 14 | 6.8 hrs | Truss | 9.2 |
| Taft Rd. | 1 | 6 | 8.6 hrs | Girder | 21.0 |
| Hastings | 0 | 2 | 7.9 hrs | Girder | 25.0 |
| Rt. 495 | 0 | 0 | 3.3 hrs. | Girder | 0.23 |
| Rt. 11C | 0 | 0 | 7.1 hrs | Truss | 25.0 |
| Rt. 22B | 0 | 2 | 9.2 hrs | Truss | 17.0 |
| Stillwater 1/2 | 0 | 7 | 11.2 hrs | Truss | 21.0 |
| Stillwater Full | 0 | 0 | 10.5 hrs | Truss | 21.0 |
| Total Exceedances | 2 | 41 | | | |

* These are bridges in New York State.

Provided by : www.spic.ir Licensee: NISOC Library

## SSPC: The Society for Protective Coatings

# TEST PANEL PREPARATION METHOD NO. 1

## Uncontaminated Rusted Steel

## 1. Scope

**1.1** This specification describes the requirements for preparing standard laboratory corroded test panels for use in evaluating coatings in accelerated or fence tests.

**1.2** Test panels prepared in accordance with this specification are intended primarily for evaluating the performance of coatings that are recommended for use on minimally prepared, minimally contaminated substrates. The test panels are intended to represent the minimally rusted steel surface after being cleaned to SSPC-SP 2 (Hand Tool Cleaning).

**1.3** Test panels prepared in accordance with this specification should not be used for evaluating the performance of coatings recommended for use over marine and industrial contaminated rusted steel.

## 2. Description

**2.1** This is a method for preparing standard corroded test panels. The method is both rapid and reproducible. Steel panels are initially prepared in accordance with SSPC-SP 10 (Near White Metal Blast Cleaning) and then exposed in a cyclic wet/dry cabinet. This produces dense uniform corrosion products. The method employs deionized water and is not intended to deposit soluble ionic species on the substrates.

## 3. Reference Standards

**3.1** The standards referenced in this guide are listed in Sections 3.4 and 3.5 and form a part of this specification.

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

**3.3** If there is a conflict between the requirements of any of the stated reference standards and this specification, the requirements of this specification shall prevail.

**3.4 SSPC AND JOINT STANDARDS:**

| | |
|---|---|
| **PA 2** | Measurement of Dry Coating Thickness with Magnetic Gages |
| **SP 1** | Solvent Cleaning |
| **SP 2** | Hand Tool Cleaning |
| **SP 10/NACE No. 2** | Near White Metal Blast Cleaning |

**3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:**

| | |
|---|---|
| **A 36** | Specification for Structural Steel |
| **G 85** | Practice for Modified Salt Spray (Fog) Testing (Annex A.5) |

## 4. Preparation of Test Panels

**4.1** Test panels shall be of A 36 steel with dimensions as agreed upon between the purchaser and supplier.

**4.2** Test panels shall be solvent cleaned in accordance with SSPC-SP 1.

**4.3** Test panels shall be abrasive blast cleaned in accordance with SSPC-SP 10, using a contaminant-free manufactured abrasive such as aluminum oxide.

## 5. Corrosion of Test Panels

**5.1** Test panels shall be exposed in a cyclic spray cabinet (see ASTM G 85, Annex A.5).

**5.2** The cyclic spray cabinet shall alternate between one hour wet (ambient temperature, deionized water) and one hour dry conditions (initial dry temperature 25°C, final dry temperature of 45°C achieved after 30 minutes).

**5.3** The total exposure time in the cyclic spray cabinet shall be 504 hours (three weeks). Panels shall be rotated through six positions in the cabinet such that each panel spends an equal amount of time at each position. The positions are the right, center, and left sides of the top and bottom rows of the cabinet. The middle row of the cabinet shall not be used except with newer models of cabinets where it can be shown that temperature variations are not greater than those observed in the right, center, and left positions of the top and bottom rows.

## 6. Inspection of Corroded Test Panels

**6.1** The corroded test panels shall be uniformly corroded over the entire surface. Between-panel variations shall not be statistically significant. Estimate uniformity of rusting by SSPC-PA 2, “Measurement of Dry Coating Thickness with Magnetic Gages.” NOTE: If the variation of rust thickness of a panel from the mean exceeds the requirement in Section 6.1.1, do not use such a panel.

Provided by : www.spic.ir Licensee: NISOC Library

**6.1.1** After measuring the rust thickness on each panel determine the mean rust thickness for the entire population of prepared panels. Determine the standard deviation from the mean rust thickness of the panel population. Discard any panels from the full population which are not within ± 2 standard deviations of the population mean rust thickness.

## 7. Preparation and Storage of Test Panels Prior to Coating Application

**7.1** Corroded test panels may be stored indefinitely under dry conditions prior to coating application and subsequent exposure testing.

**7.2** Corroded test panels shall be blown down with clean, dry compressed air prior to coating application.

## 8. Disclaimer

**8.1** While every precaution is taken to ensure that all information furnished in SSPC standards and specifications is as accurate, complete and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, or coatings or methods specified therein, or of the specification or standard itself.

8.2 This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

## Appendix A—Supplementary Information

The utility of this method was evaluated in a research project conducted by SSPC and sponsored by the U.S. Army Construction Engineering Research Lab. Key results from this study are:

**A.1 Statistically high significant agreement** (correlation between two factors at the 99% confidence level) is demonstrated between the unranked performance of coating systems applied to test panels prepared by this method when subjected to accelerated testing.

**A.2 Statistically significant agreement** (correlation between two factors at the 95% confidence level) is demonstrated between the unranked performance of coating systems applied to panels prepared by this method and naturally rusted surfaces when subjected to accelerated testing.

**A.3 Statistically high significant agreement** is demonstrated between the ranked performance of coatings applied to panels prepared by this method and naturally rusted surfaces when subjected to accelerated testing.

Provided by : www.spic.ir Licensee: NISOC Library

# REFERENCED ORGANIZATIONS

### American Association of State Highway & Transportation Officials (AASHTO)
444 North Capitol Street, NW, Suite 249
Washington, DC 20001
Tel: 202-624-5800 Fax: 202-624-5806
www.aashto.org

### American Concrete Institute (ACI)
P.O. Box 9094
Farmington Hills, MI 58333
Tel: 248-848-3700 Fax: 248-848-3701
www.aci-int.org/

### American Galvanizers Association (AGA)
6881 South Holly Circle, Suite 108
Englewood, CO 80112
Tel: 720-554-0900 Fax: 720-554-0909
www.galvanizeit.org/

### American National Standards Institute (ANSI)
11 West 42nd Street
New York, NY 10036
Tel: 212-642-4900 Fax:212-398-0023
www.ansi.org

### American Society for Testing & Materials (ASTM)
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
Tel: 610-832-9500 Fax: 610-832-9555
www.astm.org

### American Water Works Association (AWWA)
6666 West Quincy Avenue
Denver, CO 80235
Tel: 303-794-7711
www.awwa.org

### American Welding Society (AWS)
550 N.W. LeJeune Road
Miami, FL 33126
Tel: 305-443-9353 Fax: 305-443-7559
www.aws.org

### British Standards Institute (BSI)
2 Park Street
London, W1A 2BS
United Kingdom
Tel: +44(0)181-996-9000 Fax: +44(0)181-996-7400
www.bsi.org.uk/bsi

### Canadian General Standards Board (CGSB)
222 Quen St., Suite 1500
Ottawa, Ontario K1A 1G6
Canada
Tel: 819-956-0894 Fax: 819-956-1634
www.pwgsc.gc.ca

### Canadian Standards Association (CSA)
178 Rexdale Boulevard
Toronto, Ontario M9W 1R3
Canada
Tel: 416-747-4000 Fax: 416-747-4149
www.csa-international.org

### General Services Administration (GSA)
Specifications Unit (WFSIS)
7th and D Streets, SW
Washington, DC 20407
Tel: 202-619-8925
www.gsa.gov

### Information Handling Services (IHS)
15 Inverness Way East
Englewood, CO 80112
Tel: 800-790-0600 Fax: 800-525-7052
www.ihs.com/products

### ISEA - The Safety Equipment Association
1901 North Moore Street
Arlington, VA 22209-11762
Tel: 703-525-1695 Fax: 703-528-2148
www.safetycentral.org/isea/

### International Organization for Standardization (ISO)
c/o American National Standards Institute
11 West 42nd Street, 13th Floor
New York, NY 10036
Tel: 212-642-4900 Fax: 212-398-0023

### NACE International
1440 South Creek Drive
P.O. Box 218340
Houston, TX 77218-8340
Tel: 281-228-6200 Fax: 281-228-6300
www.nace.org

### National Paint & Coatings Association (NPCA)
1500 Rhode Island Ave., NW
Washington, DC 20005-5503
Tel: 202-462-6272
www.paint.org

Provided by : www.spic.ir Licensee: NISOC Library

### Naval Publications & Forms Center (NPFC)
Standards Documents Order Desk
700 Robbins Avenue, Bldg. 4D
Philadelphia, PA 19111-5098

### Society of Automotive Engineers (SAE)
400 Commonwealth Drive
Warrendale, PA 15096-0001
Tel: 724-772-4841 Fax: 724-776-1830
www.sae.org

### Society of Naval Architects & Marine Engineers (SNAME)
601 Pavonia Avenue, Suite 400
Jersey City, NJ 07306
Tel: 800-798-2188 Fax: 201-798-4975
www.sname.org

### Steel Founders' Society of America (SFSA)
Cast Metals Federation Building
455 State Street
Des Plaines, IL 670016
Tel: 847-299-9160 Fax: 847-299-3105
www.sfsa.org

### SSPC: The Society for Protective Coatings
40 24th Street, 6th Floor
Pittsburgh, PA 15222
Tel: 412-281-2331 Fax: 412-281-9992
www.sspc.org

### U.S. Army Corps of Engineers (USACE) Publications
Publications Depot
Attn: CEIM-IM-PD
2803 52nd Avenue
Hyattsville, MD 20781-1102
Tel: 301-394-0081/0082/0083 Fax: 301-394-0084
www.nws.usace.army.mil/inet/usace-docs/

### U.S. Department of the Interior
Bureau of Reclamation
P.O. Box 25007
Denver Federal Center
Denver, Co 80225-0007
Tel: 303-445-2692 Fax: 303-236-6763
www.usbr.gov/main/infozone/comments.html

Provided by : www.spic.ir Licensee: NISOC Library

# STANDARDS AND SPECIFICATIONS REFERENCED IN VOLUME 2

## American Association of State Highway and Transportation Officials (AASHTO)

M 69 Aluminum Paint
M 70 White & Tinted Ready-Mix Oil Base Paint
M 229 Basic Lead Silico Chromate, Ready-Mixed Primer
M 300 Inorganic Zinc-Rich Primer

## American Concrete Institute (ACI)

116R Cement and Concrete Terminology
224.1R Causes, Evaluation, and Repair of Cracks in Concrete Structures
503R Use of Epoxy Compounds with Concrete
504R Guide to Joint Sealants for Concrete Structures
515.1R Guide to the Use of Waterproofing, Dampproofing, Protective and Decorative Barrier Systems for Concrete

## American National Standards Institute (ANSI)

61 Drinking Water System Components - Health Effects
A13.1 Scheme for Identification of Piping Systems
A14.1 Ladders – Portable Wood – Safety requirements
A14.2 Portable Metal Ladders
C2.18 Guide for the Protection of Steel with Thermal Sprayed Coatings of Aluminum and Zinc and Their Alloys and Composites
C203 Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied
C205 Cement Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. and Larger - Shop Applied
C209 Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
C210 Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
C213 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
C215 Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines
C216 Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
C217 Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Buried Steel Water Pipelines
C652 Disinfection of Water - Storage Facilities
D1.1 Structural Welding Code, Steel
N5.12 (Canceled) Protective Coatings (Paints) for the Nuclear Power Industry
N45.2.6 Qualification of Inspection, Examination, and Testing Personnel for Nuclear Power Plants (replaced by ANSI/ASME NQA -1-1994)
N101.2 Protective Coatings (Paints) for Light Water Nuclear Reactors (withdrawn)
N101.4 Quality Assurance for Protective Coatings Applied to Nuclear Facilities Containment Facilities (withdrawn)
NQA-1 Quality Assurance Requirements for Nuclear Facility Applications (replaces ANSI/ASME N45.2.6)
RP7 Practice for Industrial Lighting
Z9.3 Exhaust Systems – Spray Finishing Operations – Safety Code for Design, Construction, and Ventilation
Z9.4 Ventilation and Safe Practices of Abrasive Blasting Operations
Z49.1 Safety in Welding and Cutting
Z53.1 Safety Color Code for Marking Physical Hazards
Z87.1 Practice for Occupational and Educational Eye and Face Protection
Z88.2 Practices for Respiratory Protection
Z89.1 Personnel Protection - Protective Headwear for Industrial Workers
Z49.1 Safety in Welding, Cutting and Allied Processes
Z117.1 Safety Requirements for Confined Spaces
Z129.1 Hazardous Industrial Chemicals – Precautionary Labeling

## American Society for Testing and Materials (ASTM)

A 36 Specification for Carbon Structural Steel
A 123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 569 Specification for Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality
A 607 Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled
A 780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
B 117 Practice for Operating Salt Spray (Fog) Apparatus
B 287 (Canceled) Method of Acetic Acid-Salt Spray (Fog) Testing
B 833 Specification for Zinc Wire for Thermal Spraying (Metallizing)
C 128 Test Method for Specific Gravity and Absorption of Fine Aggregate
C 136 Method for Sieve Analysis of Fine and Coarse Aggregates
C 267 Test Method for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings
C 279 Specification for Chemical-Resistant Masonry Units

Provided by : www.spic.ir Licensee: NISOC Library

C 287 Specification for Chemical-Resistant Sulfur Mortar
C 386 Practice for Use of Chemical-Resistant Sulfur Mortar
C 395 Specification for Chemical-Resistant Resin Mortars
C 397 Practice for Use of Chemically Setting Chemical-Resistant Silicate and Silica Mortars
C 398 Practice for Use of Hydraulic Cement Mortars In Chemical-Resistant Masonry
C 399 Practice for Use of Chemical-Resistant Resin Mortars
C 466 Specification for Chemically Setting Silicate and Silica Chemical-Resistant Mortars
C 566 Test Method for Total Moisture Content of Aggregate by Drying
C 582 Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment
C 633 Test Method for Adhesion or Cohesive Strength of Flame-Sprayed Coatings
C 658 Specification for Chemical-Resistant Resin Grouts for Brick or Tile
C 661 Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
C 702 Practice for Reducing Field Samples of Aggregate to Testing Size
C 723 Practice for Chemical-Resistant Resin Grouts for Brick or Tile
C 805 Test Method for Rebound Number of Hardened Concrete
C 811 Practice for Surface Preparation of Concrete for Application of Chemical-Resistant Resin Monolithic Surfacings
C 868 Test Method for Chemical Resistance of Protective Linings
C 1106 Test Method for Chemical Resistance and Physical Properties of Carbon Brick
C 1140 Practice for Preparing and Testing Specimens From Shotcrete Test Panels
D 4 Test Method for Bitumen Content
D 5 Test Method for Penetration of Bituminous Materials
D 12 Specification for Raw Tung Oil
D 13 Specification for Spirits of Turpentine
D 16 Terminology Relating to Paint, Varnish, Lacquer, and Related Products
D 20 Test Method for Distillation of Road Tars
D 36 Test Method for Softening Point of Bitumen Ring-and-Ball Apparatus)
D 41 Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
D 56 Test Method for Flash Point by Tag Closed Tester
D 75 Practice for Sampling Aggregates
D 79 Specification for Zinc Oxide Pigments
D 83 Specification for Red Lead Pigment
D 92 Test Method for Flash and Fire Points by Cleveland Open Cup
D 93 Test Methods for Flash Point by Pensky-Martens Closed Tester
D 95 Test Method for Water in Petroleum Products and Bituminous Materials by Distillation
D 128 Test Methods for Analysis of Lubricating Grease
D 139 Method for Float Test for Bituminous Materials
D 153 Test Methods for Specific Gravity of Pigments
D 154 Guide for Testing Varnishes
D 185 Test Methods for Coarse Particles in Pigments, Pastes, and Paints
D 209 Specification for Lampblack Pigment
D 212 (Canceled) Specification for Chrome Green Pigment
D 234 Specification for Raw Linseed Oil
D 235 Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
D 237 Specification for Orange Shellac and Other Lacs
D 263 Specification for Chrome Oxide Green Pigment
D 281 Test Method for Oil Absorption of Pigments by Spatula Rub-Out
D 296 (Canceled) Specification for Rubber-Lined Fire Hose with Woven Jacket
D 331 Specification for 2-Ethoxyethanol
D 343 (Canceled) Specification for 2-Ethoxyethyl Acetate (95% Grade)
D 344 Test Method for Relative Hiding Power of Paints by the Visual Evaluation of Brushouts
D 362 (Canceled) Specification for Industrial Grade Toluene
D 364 (Canceled) Specification for Industrial Grade Xylene (Replaced by D 846)
D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
D 413 Test Methods for Rubber Property - Adhesion to Flexible Substrate
D 429 Test Methods for Rubber Property - Adhesion to Rigid Substrates
D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
D 453 Test Method for Tar Acids in Creosote-Coal Tar Solutions
D 470 Test Methods for Crosslinked Insulations and Jackets for Wire and Cable
D 476 Specification for Titanium Dioxide Pigments
D 478 Specification for Zinc Yellow (Zinc Chromate) Pigments
D 479 (Canceled) Test Method for Reactivity of Paint Liquid
D 480 Test Methods for Sampling and Testing of Flaked Aluminum Powders and Pastes
D 484 (Canceled - Replaced by D 235)
D 520 Specification for Zinc Dust Pigment

Provided by : www.spic.ir Licensee: NISOC Library

D 521 Test Methods for Chemical Analysis of Zinc Dust (Metallic Zinc Powder)
D 522 Test Methods for Mandrel Bend Test of Attached Organic Coatings
D 523 Test Method for Specular Gloss
D 529 Test Method for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Carbon-Arc Method)
D 561 Specification for Carbon Black Pigment for Paint
D 562 Test Method for Consistency of Paints Using the Stormer Viscometer
D 600 Specification for Liquid Paint Driers
D 602 Specification for Barium Sulfate Pigments
D 604 Specifications for Diatomaceous Silica Pigment
D 605 Specification for Magnesium Silicate Pigment (Talc)
D 607 Specification for Wet Ground Mica Pigments
D 609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products
D 610 Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
D 658 Test Method for Abrasion Resistance of Organic Coatings by Air Blast Abrasive
D 660 Test Method for Evaluating Degree of Checking of Exterior Paints
D 661 Test Method for Evaluating Degree of Cracking of Exterior Paints
D 714 Test Method for Evaluating Degree of Blistering of Paints
D 715 Test Methods for Analysis of Barium Sulfate Pigment
D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
D 801 Methods for Sampling and Testing Dipentene
D 822 Practice for Conducting Tests on Paint and Related Coatings and Materials Using Filtered Open Flame Carbon-Arc Light and Water Exposure Apparatus
D 823 Practices for Producing FIlms of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels
D 843 Specification for Nitration Grade Xylene
D 846 (Canceled) Specification for Ten-Degree Xylene
D 870 Practice for Testing Water Resistance of Coatings Using Water Immersion
D 962 Specification for Aluminum Powder and Paste Pigments for Paints
D 968 Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
D 1005 Test Methods for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers
D 1010 (Canceled - Replaced by D 2939)
D 1014 Practice for Conducting Exterior Exposure Tests of Paints on Steel
D 1125 Test Methods for Electrical Conductivity and Resistivity of Water
D 1132 (Canceled) Test for Heptane Number of Hydrocarbon Solvents
D 1146 Test Method for Blocking Point of Potentially Adhesive Layers
D 1153 Specification for Methyl Isobutyl Ketone
D 1186 Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base
D 1200 Test Method for Viscosity by Ford Viscosity Cup
D 1208 Test Methods for Common Properties of Certain Pigments
D 1210 Test Method for Fineness of Dispersion of Pigment-Vehicle Systems
D 1211 Test Method for Temperature-Change Resistance of Clear Nitrocellulose Lacquer Films Applied to Wood
D 1212 Test Methods for Measurement of Wet Film Thickness of Organic Coatings
D 1227 Specification for Emulsified Asphalt Used as a Protective Coating for Roofing
D 1243 Test Method for Dilute Solution Viscosity of Vinyl Chloride Polymers
D 1259 Test Methods for Nonvolatile Content of Resin Solutions
D 1296 Test Method for Odor of Volatile Solvents and Diluents
D 1306 Test Method for Phthalic Anhydride Content of Alkyd Resins and Esters Containing Other Dibasic Acids (Gravimetric)
D 1308 Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
D 1310 Test Method for Flash Point and Fire Point of Liquids by Tag Open-Cup Apparatus
D 1398 Test Method for Fatty Acid Content of Alkyd Resins and Alkyd Resin Solutions
D 1400 Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base
D 1475 Test Method for Density of Paint, Varnish, Lacquer, and Related Products
D 1535 Practice for Specifying Color by the Munsell System
D 1542 Test Method for Qualitative Detection of Rosin in Varnishes
D 1544 Test Method for Color of Transparent Liquids (Gardner Color Scale)
D 1545 Test Method for Viscosity of Transparent Liquids by Bubble Time Method
D 1639 Test Method for Acid Value of Organic Coating Materials
D 1640 Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
D 1642 Test Methods for Elasticity or Toughness of Varnishes

Provided by : www.spic.ir Licensee: NISOC Library

D 1648 Specification for Basic Lead Silicochromate Pigment
D 1652 Test Methods for Epoxy Content of Epoxy Resins
D 1654 Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
D 1729 Practice for Visual Evaluation of Color Differences of Opaque Materials
D 1737 (Canceled) Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus
D 1849 Test Method for Package Stability of Paint
D 1856 Test Method for Recovery of Asphalt from Solution by Abson Method
D 2196 Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield) Viscometer
D 2200 Pictorial Surface Preparation Standards for Painting Steel Surfaces
D 2240 Test Method for Rubber Property – Durometer Hardness
D 2243 Test Method for Freeze-Thaw Resistance of Water-Borne Coatings
D 2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates
D 2246 (Canceled) Test Method for Finishes on Primed Metallic Substrates for Humidity-Thermal Cycle Cracking
D 2247 Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
D 2369 Test Method for Volatile Content of Coatings
D 2370 Test Method for Tensile Properties of Organic Coatings
D 2371 Test Method for Pigment Content of Solvent-Reducible Paints
D 2372 Practice for Separation of Vehicle from Solvent-Reducible Paints
D 2415 Test Method for Ash in Coal Tar and Pitch
D 2448 Test Method for Water-Soluble Salts in Pigments by Measuring the Specific Resistance of the Leachate of the Pigment
D 2471 Test Method for Gel Time and Peak Exothermic Temperature of Reacting Thermosetting Resins
D 2486 Test Method for Scrub Resistance of Interior Latex Flat Wall Paints
D 2556 Test Method for Apparent Viscosity of Adhesives Having Shear-Rate Dependent Flow Properties
D 2574 Test Method for Resistance of Emulsion Paints in the Container to Attack by Microorganisms
D 2583 Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
D 2621 Test Method for Infrared Identification of Vehicle Solids from Solvent-Reducible Paints
D 2697 Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings
D 2698 Test Method for the Determination of Pigment Content of Solvent-Reducible Paints by High Speed Centrifuging
D 2794 Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
D 2800 Test Method for Preparation of Methyl Esters from Oils for Determination of Fatty Acid Composition by Gas-Liquid Chromatography
D 2801 (Canceled) Test Method for Leveling Characteristics of Paints by Draw-Down Method
D 2805 Test Method for Hiding Power of Paints by Reflectometry
D 2832 Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings
D 2933 (Canceled) Test Method for Corrosion Resistance of Coated Steel Specimens (Cyclic Method)
D 2939 Test Methods for Testing Emulsified Bitumens Used as Protective Coatings
D 3273 Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
D 3274 Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation
D 3278 Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus
D 3335 Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
D 3359 Test Methods for Measuring Adhesion by Tape Test
D 3363 Test Method for Film Hardness by Pencil Test
D 3372 Test Method for Molybdenum in Water
D 3450 Test Method for Washability Properties of Interior Architectural Coatings
D 3486 (Canceled) Practices for Installation of Vulcanizable Rubber Tank Linings and Pipe Linings
D 3630 Standard Guide for Determining Constituents Classified as Hazardous Contained in Protective Coatings
D 3718 Standard Test Method for Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy
D 3719 Test Method for Quantifying Dirt Collection on Coated Exterior Panels
D 3721 Specification for Synthetic Red Iron Oxide Pigment
D 3722 Specification for Natural Red and Brown Iron Oxide Pigments
D 3723 Test Method for Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing
D 3724 Specification for Synthetic Brown Iron Oxide Pigment
D 3728 Specification for 2-Ethoxyethyl Acetate (99% Grade)
D 3734 Specification for High-Flash Aromatic Naphthas
D 3792 Test Method for Water Content of Water-Reducible Paints by Direct Injection into a Gas Chromatograph

Provided by : www.spic.ir Licensee: NISOC Library

D 3843 Practice for Quality Assurance for Protective Coatings Applied to Nuclear Facilities
D 3911 Test Method for Evaluating Coatings Used In Light-Water Nuclear Power Plants at Simulated Design Basis Accident (DBA) Conditions
D 3912 Test Method for Chemical Resistance of Coatings Used in Light-Water Nuclear Power Plants
D 3924 Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials
D 3925 Practice for Sampling Liquid Paints and Related Pigmented Coatings
D 3941 Test Method for Finite Flash Point of Liquids by the Equilibrium Closed Cup Method
D 3951 Practice for Commercial Packaging
D 3960 Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
D 4017 Test Method for Water in Paints and Paint Materials by Karl Fischer Method
D 4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
D 4062 Test Method for Leveling of Paints by Draw-Down Method
D 4082 Test Method for Effects of Radiation On Coatings Used in Light-Water Nuclear Power Plants
D 4097 Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks
D 4138 Test Method for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive Means
D 4212 Test Method for Viscosity by Dip-Type Viscosity Cups
D 4214 Test Methods for Evaluating Degree of Chalking of Exterior Paint Films
D 4227 Practice for Qualification of Journeyman Painters for Application of Coatings to Concrete Surfaces of Safety-Related Areas in Nuclear Facilities
D 4228 Practice for Qualification of Journeyman Painters for Application of Coatings to Steel Surfaces of Safety Related Areas in Nuclear Facilities
D 4256 Test Method for Determination of the Decontaminability of Coatings Used in Light-Water Nuclear Power Plants
D 4258 Practice for Surface Cleaning Concrete for Coating
D 4259 Practice for Abrading Concrete
D 4260 Practice for Acid Etching Concrete
D 4261 Practice for Surface Cleaning Concrete Unit Masonry for Coating
D 4262 Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
D 4263 Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
D 4285 Method for Indicating Oil or Water in Compressed Air
D 4357 Specification for Plastic Laminates Made from Woven Roving and Woven Yarn Glass Fabrics
D 4400 Test Methods for Sag Resistance of Paints Using a Multinotch Applicator
D 4414 Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages
D 4417 Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
D 4457 Test Method for Analysis of Dichloromethane and 1,1,1,-Trichloroethane in Paints and Coatings by Direct Injection into a Gas Chromatograph
D 4537 Guide for Establishing Procedures to Qualify and Certify Inspection Personnel for Coating Work In Nuclear Facilities
D 4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
D 4585 Practice for Testing the Water Resistance of Coatings Using Controlled Condensation
D 4587 Practice for Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water-Exposure Apparatus
D 4618 Specification for the Design and Fabrication of Flue Gas Desulfurization System Components for Protective Linings
D 4752 Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub
D 4787 Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
D 4796 Test Method for Bond Strength of Thermoplastic Traffic Marking Materials
D 4828 Test Method for Practical Washability of Organic Coatings
D 4834 Test Method for Detection of Lead in Paint by Direct Aspiration Atomic Absorption Spectroscopy
D 4920 Terminology Relating to Moisture in Textiles
D 4940 Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives
D 5043 (Canceled) Test Methods for Field Identification of Coatings
D 5064 Practice for Conducting a Patch Test to Assess Coating Compatibility
D 5065 Guide for Assessing the Condition of Aged Coatings on Steel Surfaces
D 5162 Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coatings on Metallic Substrates
D 5402 Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs
D 5486 Specification for Pressure-Sensitive Tape for Packaging, Box Closure, and Sealing
D 5590 Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

Provided by : www.spic.ir Licensee: NISOC Library

D 5894 Practice for Cyclic Corrosion/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
D 5962 Standard Guide for Maintaining Unqualified Coatings (Paints) Within Level 1 Areas of a Nuclear Power Facility
D 6132 Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Over Concrete Using an Ultrasonic Gage
D 6133 Test Method for Acetone Content of Solvent-Reducible and Water-Reducible Paints, Coatings, Resins, and Raw Materials by Direct Injection Into a Gas Chromatograph
E 11 Specification for Wire-Cloth Sieves for Testing Purposes
E 29 Test Method for Softening Point by Ring-and-Ball Apparatus
E 96 Test Methods for Water Vapor Transmission of Materials
E 97 (Canceled) Test Method for Directional Reflectance Factor, 45-deg 0-deg, of Opaque Specimens by Broad-Band Filter Reflectometry
E 140 Hardness Conversion Tables for Metals (Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Rockwell Superficial Hardness, Knopp Hardness, and Scleroscope Hardness)
E 337 Test Method for Measuring Humidity with a Psychrometer (The Measurement of Wet- and Dry Bulb Temperatures)
E 350 Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron
E 384 Test Method for Microhardness of Materials
E 1132 Practice for Health Requirements Relating to Occupational Exposure to Quartz Dust
E 1309 Guide for Identification of Composite Materials in Computerized Material Property Databases
E 1347 Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry
E 1338 Guide for Identification of Metals and Alloys in Computerized Material Property Databases
E 1907 Practices for Determining Moisture-Related Acceptability of Concrete Floors to Receive Moisture-Sensitive Finishes
F 1869 Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
G 8 Test Methods for Cathodic Disbonding of Pipeline Coatings
G 14 Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)
G 23 (Canceled) Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials [Replace with appropriate cycle of G 151 to G 155.]
G 26 (Canceled) Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials [Replace with appropriate cycle of G 151 to G 155.]
G 42 Test Method for Cathodic Disbonding of Pipeline Coatings Subjected to Elevated Temperatures
G 53 (Canceled) Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV Condensation Type) for Exposure of Nonmetallic Materials [Replace with appropriate cycle of G 151 to G 155.]
G 85 Practice for Modified Salt Spray (Fog) Testing
G 87 Practice for Conducting Moist SO2 Tests
G 92 Practice for Characterization of Atmospheric Test Sites
G 151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that use Laboratory Light Sources
G 152 Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
G 153 Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
G 154 Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
G 155 Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials

## American Water Works Association (AWWA)

C203 Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied
C205 Cement Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. and Larger - Shop Applied
C209 Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
C210 Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
C213 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
C215 Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines
C216 Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
C217 Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Buried Steel Water Pipelines
C652 Disinfection of Water - Storage Facilities
D102 Painting Steel Water-Storage Tanks

## American Welding Society (AWS)

B4.0 Standard Methods for Mechanical Testing of Welds
C1.1 Recommended Practices for Resistance Welding

Provided by : www.spic.ir Licensee: NISOC Library

C2.18 Guide for the Protection of Steel with Thermal Sprayed Coatings of Aluminum and Zinc and Their Alloys and Composites
D1.1 Structural Welding Code, Steel
TS-85 Thermal Spraying - Practice, Theory, and Application
Z49.1 Safety in Welding, Cutting and Allied Processes

## Boeing Material Specification

BMS-10-60 Protective Enamel

## British Standards Institute (BSI)

2569 Specification for Sprayed Metal Coatings
5493 Code of Practice for Protective Coatings of Iron and Steel Structures Against Corrosion

## Bureau of Reclamation

CA-50 Cold-Applied Coal-Tar Paint
CTP-3 Coal-Tar Paint
VR-3 Vinyl Resin Paint
VR-6 Vinyl Resin Paint
VR-M Vinyl Resin Mastic

## Canadian General Standards Board (CGSB)

1-GP-166 Primer, Basic Lead Silico-Chromate, Oil Alkyd Type
1-GP-171 Coating, Inorganic Zinc
1-GP-177 Coating, Polyurethane, Two-Package, Resistant to Chalking and Yellowing
1-GP-180 Coating, Polyurethane, Two-Package, General Purpose
1-GP-181 Coating, Zinc-Rich, Organic, Ready Mixed

## Canadian Standards Association (CSA)

G 189 Sprayed Metal Coatings for Atmospheric Corrosion Protection

## Coast Guard

CGS-52 Paint: Aluminum Ready Mixed

## Corps of Engineers Specifications

CW-09940 Painting: Hydraulic Structures
V-106 Vinyl-Type, Red Oxide (Light or Dark Color) Paint
V-766 Vinyl-Type White (or Gray) Paint
VZ-108 Vinyl-Type Zinc-Rich Primer

## Deutsches Institut Für Normüng E. V. (German Standards Organization; DIN)

30672 Corrosion Protection, Tapes and Shrink Sleeves. Pipe Wrappings of Corrosion Protection Tape and Shrink Sleeves for Underground Pipelines Destined for Gas and Water Supply
55928 Protection of Steel Constructions from Corrosion by Organic and Metal Coatings

## Federal Standards

FED-STD-595: Colors Used in Government Procurement
FED-STD-141: Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing
Section 9 Routine and Referee Testing Conditions
Method 2011 Preparation of Steel Panels
Method 2012 Preparation of Tin Panels
Method 2021 Preparation of Glass Panels
Method 2161 Application of Film with Film Application (Magnetic Chuck)
Method 3011 Condition in Container
Method 3021 Skinning (Partially Filled Container)
Method 4021 Pigment Content (Ordinary Centrifuge)
Method 4053 Nonvolatile Vehicle Content
Method 4061 Drying Time
Method 4081 (Canceled) Water Content (Reflux Method)
Method 4092 Coarse Particles and Skins in Synthetic Vehicle Enamels, Lacquers and Dopes
Method 4203 Reducibility and Dilution Stability
Method 4311 (Canceled) Volume Percentage of Pigment in Total Nonvolatile Matter (Calculation Method)
Method 4321 Brushing Properties
Method 4331 Spraying Properties
Method 4494 Sag Test (Multinotch Blade)
Method 4541 Working Properties and Appearance of Dried Film
Method 6141 Washability
Method 6221 Flexibility
Method 7014 Analysis of Unsaponifiable Matter, Oil Acids, and Phthalic Anhydride in Alkyd Vehicles

## Code of Federal Regulations (CFR)

16 CFR 1303 Ban of Lead-Containing Paint and Certain Consumer Products Bearing Lead-Containing Paint
29 CFR 1910.94 Occupational Health and Environmental Control—Ventilation
29 CFR 1910.1018 Inorganic Arsenic (General Industry Standard)
29 CFR 1910.1025 Lead (General Industry Standard)
29 CFR 1910.146 Permit Required Confined Spaces
29 CFR 1926 Safety and Health Regulations for Construction
29 CFR 1926.55 Gases, Vapors, Fumes, Dusts and Mists
29 CFR 1926.62 Lead (Construction Industry Standard)
29 CFR 1926.63 Cadmium (Construction Industry Standard)

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| 40 CFR, 50, Appendix G | National Ambient Air Quality Standard for Lead |
| 40 CFR 60, Appendix A, Method 9 | Determination of Volatile Matter Visual Determination of the Opacity of Emissions from Stationary Sources |
| Method 22 | Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Fires. |
| Method 24 | Content, Water Content, Density, Volume |
| 40 CFR 260 | Hazardous Waste Management System: General |
| 40 CFR 261 | Identification and Listing of Hazardous Waste |
| 40 CFR 262 | Standards Applicable to Generator of Hazardous Waste |
| 40 CFR 263 | Standards Applicable to Transporters of Hazardous Waste |
| 40 CFR 264 | Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities |
| 40 CFR 265 | Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities |

## Department of Defense

| | |
|---|---|
| DoD-P-15328 | Primer (Wash), Pretreatment (Formula No. 117 for Metals) |
| DoD-P-17545 | (Canceled) Primer Coating, Alkyd-Red Lead Type, Formula Nos. 116 and 116D (use TT-P-645) |
| DoD-P-21035 | Paint, High Zinc Dust Content, Galvanizing Repair |
| DoD-P-23236 | [See MIL-PRF-23236] |
| DoD-STD-2138 | Metal Sprayed Coating Systems for Corrosion Protection Aboard Naval Ships |

## Department of Health and Human Services

| | |
|---|---|
| NIOSH Method 7082 | Lead |

## Environmental Protection Agency

| | |
|---|---|
| Method 3050 | Acid Digestion of Sediments, Sludges, and Soils |
| SW 846 | Evaluating Solid Wastes |

## Federal Specifications and Commercial Item Descriptions

| | |
|---|---|
| A-A-379 | (Canceled) Linseed Oil, Raw (for Use in Organic Coatings) (Use ASTM D 234) |
| A-A-714 | Linseed Oil, Alkali Refined |
| A-A-1632 | Varnish, Asphalt |
| A-A-1800 | Varnish, Oil; Spar |
| A-A-2904 | Thinner, Paint, Mineral Spirits, Regular and Odorless |
| A-A-2962 | Enamel, Alkyd, Exterior, Solvent based, Low VOC |
| A-A-3054 | Paint: Heat Resisting (204 Deg. C) |
| A-A-59106 | Ethylene Glycol Monoethyl Ether, Technical |
| A-A-59107 | Toluene, Technical |
| A-A-59124 | Deck Covering, Lightweight, Nonslip |
| A-A-59166 | Coating Compound, Nonslip (for Walkways) |
| A-A-59295 | Corrosion Preventive Compounds, Cold Application (for New and Fielded Motor Vehicles and Trailers) |
| BB-A-1034 | Compressed Air, Breathing |
| PPP-P-1892 | Paint, Varnish, Lacquer, and Related Materials; Packaging, Packing and Marking of |
| PPP-T-60 | (Canceled) Tape: Packaging, Waterproof (Use ASTM D 5486) |
| R-P-381 | (Canceled) Pitch, Coal-Tar: (For) Aggregate-Surfaced Built-Up Roofing, Waterproofing and Dampproofing |
| SS-A-701 | (Canceled) Asphalt, Petroleum (Primer, Roofing, and Waterproofing) (Use ASTM D 41) |
| TT-C-490 | Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings |
| TT-C-494 | Coating Compound, Bituminous, Solvent Type, Acid Resistant |
| TT-C-520 | (Canceled) Coating compound, Bituminous, Solvent Type, Underbody (for Motor Vehicles) (Refer to A-A-59295) |
| TT-D-376 | (Canceled) Dipentene, Technical (for Use in Organic Coatings) |
| TT-E-489 | Enamel, Alkyd, Gloss (Low VOC Content) |
| TT-E-490 | (Canceled) Enamel, Silicone Alkyd Copolymer, Semigloss (for Exterior and Interior Non-Residential Use) (Use MIL-E-24635) |
| TT-E-496 | (Canceled) Enamel, Heat-Resisting (400°F, Black) (Use A-A-3054) |
| TT-E-506 | (Canceled) Enamel, Alkyd, Gloss, Tints and White (for Interior Use) (Use A-A 2962 or TT-E-2784) |
| TT-E-527 | Enamel, Alkyd, Lustreless, Low VOC Content |
| TT-E-529 | Enamel, Alkyd, Semigloss, Low VOC Content |
| TT-E-781 | (Canceled) Ethylene Glycol Monoethyl Ether, Technical (Refer to A-A-59106) |
| TT-E-1593 | Enamel, Silicone Alkyd Copolymer, Gloss (for Exterior and Interior Use) |
| TT-E-2784 | Enamel (Acrylic-Emulsion, Exterior) |
| TT-L-215 | (Canceled) Linseed Oil, Raw (for Use in Organic Coatings) (Use ASTM D 234) |

Provided by : www.spic.ir Licensee: NISOC Library

| | |
|---|---|
| TT-L-1155 | (Canceled) Linseed Oil, Alkali Refined (Refer to A-A-714) |
| TT-N-97 | Naphtha: Aromatic |
| TT-P-28 | Paint, Aluminum, Heat Resisting (1200°F) |
| TT-P-31 | (Canceled) Paint, Oil: Iron-Oxide, Ready-Mixed, Red and Brown |
| TT-P-86 | (Canceled) Paint, Red-Lead-Base, Ready-Mixed |
| TT-P-320 | (Canceled) Pigment, Aluminum: Powder and Paste, for Paint |
| TT-P-615 | (Canceled) Primer Coating, Alkyd, Wood and Ferrous Metal (Use TT-P-664 or MIL-P-53030) |
| TT-P-641 | (Canceled) Primer Coating, Zinc Dust-Zinc Oxide for Galvanized Surfaces (Use MIL-DTL-24441) |
| TT-P-645 | Primer, Paint Zinc-Molybdate, Alkyd Type (Formerly Zinc-Chromate) |
| TT-P-664 | Primer Coating, Alkyd, Corrosion Inhibiting, Lead and Chromate Free, VOC-Compliant |
| TT-P-1046 | (Canceled) Primer Coating, Zinc Dust, Chlorinated Rubber, (for Steel and Galvaized Surfaces) |
| TT-T-251 | Remover; Paint (Organic Solvent Type) |
| TT-R-266 | Resin, Alkyd: Solutions |
| TT-T-291 | (Canceled) Thinner, Paint, Mineral Spirits, Regular and Odorless (Use A-A-2904) |
| TT-T-548 | (Canceled) Toluene, Technical (Refer to A-A-59107) |
| TT-V-51 | (Canceled) Varnish: Asphalt (Use A-A-1632) |
| TT-V-121 | (Canceled) Varnish, Spar, Water-Resisting (Use A-A-1800) |

## International Organization for Standardization (ISO)

| | |
|---|---|
| 2063 | Metallic and other organic coatings—Thermal spraying—Zinc, aluminum, and their alloys |
| 8501-1 | Preparation of steel substrates before application of paints and related products—Visual assessment of surface cleanliness—Part I: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings |
| 4628-3 | Paints and varnishes—Evaluation of degradation of paint coatings—Designation of intensity, quantity and size of common types of defect—Part 3: Designation of degree of rusting |
| 8502 | Preparation of steel substrates before application of paint and related products—Tests for assessment of surface cleanliness |
| Part 1 | Field test for soluble iron corrosion products [Technical Report] |
| Part 2 | Laboratory determination of chloride on cleaned surfaces |
| Part 3 | Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method) |
| Part 5 | Measurement of chloride on steel surfaces prepared for painting—Ion detection tube method |
| Part 6 | Extraction of soluble contaminants for analysis—The Bresle method |
| Part 9 | Field method for the conductimetric determination of water-soluble salts |
| 11124-3 | Preparation of steel substrates before application of paints and related products—Specifications for metallic blast cleaning abrasives—Part 3: High-carbon cast-steel shot and grit |
| 11127 | Preparation of steel substrates before application of paints and related products—Test methods for non-metallic blast-cleaning abrasives |
| Part 6 | Determination of water-soluble contaminants by conductivity measurement |
| Part 7 | Determination of water-soluble chlorides |

## Maritime Administration Standard

| | |
|---|---|
| 52-MA-602 | (Canceled) Compounds: Rust Preventive |

## Military Specifications

| | |
|---|---|
| MIL-A-3029 | (Canceled) Asphalt, Waterproofing (for use in Manufacture of Ammunition Containers) |
| MIL-A-15206 | (Canceled) Aluminum Stearate, Technical |
| MIL-C-429 | Chlorinated Paraffin, Technical |
| MIL-C-4556 | (Canceled) (See MIL-PRF-4556) |
| MIL-C-11796 | Corrosion Preventive Compound, Petrolatrum, Hot Application |
| MIL-C-15203 | (Canceled) Coating Compound, Bituminous, Emulsion Type, Coal-Tar Base |
| MIL-C-15970 | (Canceled) Conversion Kits for 1000 and 2000 GPD Vaspor Compression Distilling Plants |
| MIL-C-16173 | Corrosion-Preventive Compound, Solvent Cutback, Cold Application |
| MIL-C-18480 | Coating Compound, Bituminous, Solvent, Coal-Tar Base |
| MIL-C-46168 | Coating, Aliphatic Polyurethane, Chemical Agent Resistant |
| MIL-C-62218 | (Canceled) Corrosion Preventive Compounds, Cold-Application (for New and Fielded Motor Vehicles and trailers) (Refer to A-A-59295) |
| MIL-C-81773 | (Canceled) Coating, Polyurethane, Aliphatic, Weather Resistant (Use MIL-PRF-85285 |
| MIL-C-83286 | (Canceled) Coating, Urethane, Aliphatic Isocyanate, for Aerospace Applications (Refer to MIL-PRF-85285) |

Provided by : www.spic.ir Licensee: NISOC Library

MIL-C-83466 (Canceled) Coating, Polyurethane, Aliphatic Isocyanate, Thermal Fuel Resistant for Aerospace Applications (Refer to MIL-PRF-85285)
MIL-C-85285 Coating: Polyurethane, High-Solids (See MIL-PRF-85285)
MIL-DTL-24441 Paint, Epoxy-Polyamide, General Specification for (Essentially Type III and Type IV of the former MIL-P-24441)
MIL-E-15145 (Canceled) Enamel, Zinc Dust Pigmented, Fresh Water Protective, Formula No. 102
MIL-E-15935 (Canceled) Enamel, Outside, Gray, Vinyl-Alkyd (Use MIL-E-24635)
MIL-E-15936 (Canceled) Enamel, Exterior, Gray, No. 27 Vinyl-Alkyd (Use MIL-E-24635)
MIL-E-16188 (Canceled) Enamel, Exterior, Gray, No 17 (Vinyl Alkyd) (Use TT-P-645)
MIL-E-16738 (Canceled) Enamel, Exterior, White, Vinyl-Alkyd (Use TT-P-645)
MIL-E-24292 (Canceled) Enamel, Exterior, Dark Gray (Vinyl-Alkyd) (Use MIL-DTL-24441)
MIL-E-24306 (Canceled) Enamel, Exterior, Black (Vinyl-Alkyd) (Formula No. 1220Ro1.8) (Use MIL-DTL-24441)
MIL-E-24307 (Canceled) Enamel, Exterior, Gray (Vinyl-Alkyd) (Use MIL-DTL-24441)
MIL-E-24635 Enamel, Silicone Alkyd Copolymer
MIL-E-82401 Enamel, Exterior, Vinyl-Alkyd, Red
MIL-L-2104 (See MIL-PRF-2104)
MIL-L-2638 (Canceled) Lacquer, Vinyl Resin, Gaso line and Water Resistant (Use MIL-PRF-4556)
MIL-P-14105 Paint, Heat-Resisting, (for Steel Surfaces)
MIL-P-15147 (Canceled) Primer and Enamel, Coal Tar (Use SSPC-PS 10.01, AWWA C 203)
MIL-P-15328 (See DoD-P-15328)
MIL-P-15929 (Canceled) Primer Coating, Shipboard, Vinyl-Red Lead (Use Formula 150 of MIL-P-24441 or Formula 120 of MIL-P-15930)
MIL-P-15930 Primer Coating, Shipboard, Vinyl-Zinc Chromate (Formula No. 120)
MIL-P-15931 Paint, Antifouling, Vinyl (Formulas No. 121 and No. 129)
MIL-P-23236 (Canceled) (Use MIL-PRF-23236)
MIL-P-24441 (Canceled) Paint, Epoxy-Polyamide, General Specification for (Refer to MIL-DTL-24441)
MIL-P-26915 Primer Coating, Zinc Dust Pigmented for Steel Surfaces
MIL-P-28641 (Canceled) Primer Coating, Vinyl Chloride-Acetate Copolymer, High-Build (for Steel and Masonry) (Use MIL-DTL-24441, MIL-PRF-85285)
MIL-P-28642 (Canceled) Paint (Topcoat), Vinyl Chloride Acetate Copolymer, High Build (for Steel and Masonry) (Use MIL-DTL-24441, MIL-PRF-85285)
MIL-P-38336 Primer Coating, Inorganic, Zinc Dust Pigmented, Self-Curing, for Steel Surfaces
MIL-P-46105 (Canceled) Primer Coating: Weld-Through, Zinc-Rich (See SSPC-Paint 30)
MIL-P-53030 Primer Coating, Epoxy, Water Reducible, Lead and Chromate Free
MIL-PRF-2104 Lubricating Oil, Internal Combustion Engine, Combat/Tactical Service
MIL-PRF-4556 Coating Kit, Epoxy, for Interior of Steel Fuel Tanks
MIL-PRF-23236 Paint Coating Systems, Fuel and Salt Water Ballast Tanks (Metric)
MIL-PRF-62218 (Canceled) (Refer to A-A-59295)
MIL-PRF-85285 Coating: Polyurethane, High-Solids
MIL-R-3472 (Canceled) Roof Coating, Asphalt-Base Emulsion (Use ASTM D 1227)
MIL-STD-2138 Metal Sprayed Coatings for Corrosion Protection Aboard Naval Ships (Metric)
MIL-W-5044 (Canceled) Walkway Compound, Nonslip, and Walkway Matting, Nonslip (Refer to A-A-59166 and A-A-59124)
MIL-W-6712 Wire: Metallizing

## Nace International (NACE)

6G191 Committee Report on Surface Preparation of Contaminated Concrete for Corrosion Control
RP0169 Control of External Corrosion on Underground or Submerged Metallic Piping Systems
RP0172 (Canceled) Surface Preparation of Steel and Other Hard Materials by Water Blasting Prior to Coating or Recoating
RP0178 Fabrication Details, Surface Finish Requirements and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service (Note: A visual aid is available, which should be used with the written standard.)
RP0181 Liquid-Applied Internal Protective Coatings for Oilfield Production Equipment
RP0188 Discontinuity (Holiday) Testing of Protective Coatings
RP0191 The Application of Internal Plastic Coatings for Oilfield Tubular Goods and Accessories
RP0274 High-Voltage Electrical Inspection of Pipeline Coatings Prior to Installation
RP0287 Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape
RP0288 Inspection of Linings on Steel and Concrete
RP0375 Wax Coating Systems for Underground Piping Systems

Provided by : www.spic.ir Licensee: NISOC Library

RP0490 Holiday Detection of Fusion-Bonded Epoxy External Pipeline Coatings of 250 to 760 micrometers (10 to 30 mils)

TM0174 Laboratory Methods for the Evaluation of Protective Coatings and Lining Materials in Immersion Service

TM0186 Holiday Detection of Internal Tubular Coatings of 250 to 760 micrometers (10 to 30 Mils) Dry Film Thickness

### National Fire Protection Association (NFPA)

58 Standard for the Storage and Handling of Liquefied Petroleum Gases at Utility Gas Plants

70 National Electric Code

70E Standard for Electrical Safety Requirements for Employee Workplaces

77 Recommended Practice on Static Electricity

497A Recommended Practice for the Classification of Class I Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

497B Recommended Practice for the Classification of Class II Hazardous (Classified) Locations for Electrical Installation in Chemical Process Areas

497M Manual for Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous (Classified) Locations

654 Standard for Prevention of Fire and Dust Explosions in Chemical, Dye, Pharmaceutical, and Plastics Industries

### Naval Facilities Engineering Command (NAVFAC)

### Naval Facilities Guide Specifications (NFGS)

NFGS-09872 (Canceled) Interior Coatings for Welded Steel Tanks (for Petroleum Fuels)(Use NFGS-09970)

NFGS-09874 (Canceled) Exterior Coating System for Welded Steel Petroleum Storage Tanks (Use NFGS-09971)

NFGS-09877 (Canceled) Coating of Steel Waterfront Structures (Use NFGS-09967)

NFGS-09967 Coating of Steel Waterfront Structures

NFGS-09970 Interior Coatings for Welded Steel Tanks (for Petroleum Use)

NFGS-09971 Exterior Coating systems for Welded Steel Petroleum Storage Tanks

### Naval Sea Systems Command (NAVSEA)

S9086-VD-STM-000/CH-631 Naval Ships' Technical Manual, Chapter 631, Preservation of Ships in Service (Surface Preparation and Painting)

### NSF International (NSF)

61 Drinking Water System Components—Health Effects

70 National Electric Code

### Society of Automotive Engineers (SAE)

J444 Cast Shot and Grit Size Specifications for Peening and Cleaning

J445 Metallic Shot and Grit Mechanical Testing

J827 Cast Steel Shot

### South African Bureau of Standards (SABS)

Method 768 Reflectometer

Method 770 Water Soluble Contaminants

Method 771 Tape Method

### Steel Founders' Society of America (SFSA)

20-66 Cast Steel Abrasives

### Swedish Standards Institution

SIS 05 59 00 Pictorial Surface Preparation Standard for Painting Steel Surfaces

### Underwriters' Laboratories (UL), ANSI Approved

298 Portable Electric Hand Lamps

781 Portable Electric Lighting Units for Use in Hazardous (Classified) Locations

1570 Fluorescent Lighting Fixtures

1571 Incandescent Lighting Fixtures

1572 High Intensity Discharge Lighting Fixtures

### Water and Power Resource Service

See Bureau of Reclamation

Provided by : www.spic.ir Licensee: NISOC Library