



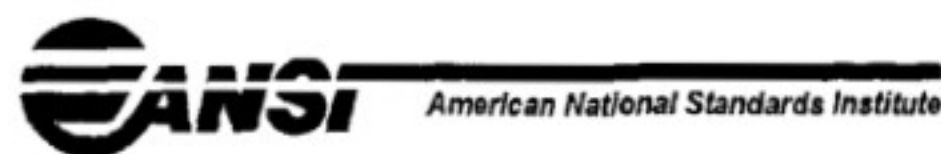
**American Water Works
Association**

ANSI/AWWA C218-02
(Revision of ANSI/AWWA C218-99)

The Authoritative Resource for Safe Drinking WaterSM

AWWA Standard

Coating the Exterior of Aboveground Steel Water Pipelines and Fittings



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AWWA Standard

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Foreword

This foreword is for information only and is not a part of AWWA C218.

I. Introduction.

I.A. *Background.* Preventing the corrosion of aboveground steel water pipe subjected to atmospheric weathering has become an increasing concern over the years. The increasing incidence of atmospheric corrosive conditions, such as acid rain, has prompted water suppliers to evaluate the paint and coating systems used to protect aboveground steel water pipe.

Although not all aboveground steel water pipe is subjected to the same atmospheric corrosive conditions, a review of the paint and coating systems currently available to the industry has become necessary. The purchasers must have the option of selecting a system that best suits their needs. These needs may be based on current surface preparation; the types of volatile organic compound (VOC) allowances permitted by regulatory agencies; and regulatory requirements for lead abatement. The paint and coating systems in this standard are designed to assist the user in producing specifications to meet these needs.

I.B. *History.* In November 1986, the AWWA Standards Council authorized AWWA's Steel Pipe Committee to develop a new standard for coatings to be used on aboveground steel water pipe exposed to the atmosphere. The first edition of this standard was published as ANSI/AWWA C218-91, Standard for Coating the Exterior of Aboveground Steel Water Pipelines and Fittings, with an effective date of Nov. 1, 1991. The second edition of this standard was approved by the AWWA Board of Directors on June 17, 1995. The third edition of the standard was approved on Jan. 24, 1999. This fourth edition was approved by the AWWA Board of Directors on June 16, 2002.

I.C. *Acceptance.* This standard has no applicable information for this section.

II. Special Issues.

II.A. *Advisory Information on Product Use.* This standard defines the performance and quality of external pipe coatings and coating systems designed to protect and prevent atmospheric corrosion. This standard applies to the exterior coating of aboveground steel water pipelines and the associated fittings installed aboveground, outdoors, or inside an associated pump station, valve chamber, or other water facilities. The coating systems cited in this standard are not all-inclusive but are those

most commonly used with an accepted performance record. Before selecting and specifying any of these coating systems, the purchaser should determine their suitability for the intended service.

II.A.1. General. This standard presents several alternative coating systems currently in use in the water industry, often serving dual functions of corrosion protection and aesthetics. Another function of coating systems may be to color code the pipe to identify the type of service.

To comply with federal, state, provincial, and local environmental regulations, most coating manufacturers are reformulating their coatings to comply with the current regulations. Some of the coatings discussed in this standard have been used successfully as solvent-base coatings for the last 20 to 30 years but are now available as water-based coatings. Others have been reformulated to reduce the amount of solvents, resulting in coatings with much lower VOCs. In some cases, high solids coatings have been developed in which the solids content exceeds 80 percent and may reach 100 percent. Primers are being reformulated to remove heavy metals and toxic inhibitors.

In many instances, these changes have altered the application, curing, adhesion, and inhibiting characteristics of coating systems. The manufacturer should be consulted for the technical data and material safety data sheets, which provide the prospective user with the information necessary to select the coating system that best satisfies the purchaser's requirements.

Materials. Code of Federal Regulations 29,* Labor-Part 1910, Occupational Safety and Health Administration (OSHA) regulations establish restrictive limits on the constructor regarding inhaling or absorbing lead- and chromate-bearing pigments and solvents through the skin. This regulation refers to shop applications, and it can significantly increase the cost of shop coating applications.

Whenever coating materials are referenced to federal, military, or other standards, the reference identifies a generic type of coating material or system.

Selecting coating systems. Several generic coating systems (see Table 1) are included in this standard, because no single coating or coating system is appropriate for all service applications. Often it is impractical for an occasional coatings user to make sufficient laboratory tests to verify and compare the relative performance

* Available from the US Government Printing Office, Superintendent of Documents, Washington, DC 20402.

characteristics of various coating systems to a given set of performance criteria. Consequently, it is necessary for the purchaser to consider the atmospheric and environmental conditions of service to which the coating or coating system will be exposed. Refer to Sec. 6 and Table 3, SSPC* Painting Manual Vol. 2, *Systems and Specifications*, Eighth edition (2000), Chap. 1, for definitions of atmospheric and environmental conditions of service.

The coatings listed in this standard have been used extensively and have provided excellent corrosion protection and weathering endurance. In recent years, the development of new polymers, pigments, and solvents has contributed to the rapid advancement of materials technology for painting and coating of steel structures. These advancements, coupled with regulatory agency concerns about air pollution by VOCs, have led to the development of many new paint formulations. Although not listed in this standard, many of these new products provide performance equal to or better than the systems presented in this standard.

III. Use of This Standard. AWWA has no responsibility for the suitability or compatibility of the provisions of this standard to any intended application by any user. Accordingly, each user of this standard is responsible for determining that the standard's provisions are suitable for and compatible with the user's intended application.

III.A. Purchaser Options and Alternatives. The following items should be included in the purchaser's specifications:

1. Standard used, that is, ANSI/AWWA C218, Standard for Coating the Exterior of Aboveground Steel Water Pipelines and Fittings, of latest revision.
2. Any exceptions to the standard that may be required.
3. Diameter, length, and location of the pipeline.
4. Affidavit of compliance, if required (Sec. 6.3).
5. Coating system to be supplied (Sec. 4.2).
6. Color, if special color is specified (Sec. 4.2.2, 4.2.3, 4.2.4, 4.2.5, 4.2.6, 4.2.8, 4.2.9, and 4.2.10).
7. Verification of film thickness of the coating or coating system (Sec. 4.3.2.4).
8. Surface preparation (Sec. 4.4).
9. Requirements for visual comparative standards for blast cleaning (Sec. 4.4.2.1).

*SSPC: The Society for Protective Coatings, 40 24th St., Sixth Floor, Pittsburgh, PA 15222.

10. Application (Sec. 4.5).
11. Coating of special pipe fittings and appurtenances (Sec. 4.5.12).
12. Inspection (Sec. 5.1).
13. Previously coated pipe (Sec. 4.4.1.2).
14. Stacking (Sec. 6.1.1).

III.B. *Modification to Standard.* Any modification of the provisions, definitions, and terminology in this standard must be provided in the purchaser's specifications.

IV. **Major Revisions.** Major revisions made to the standard in this edition include the following:

1. References were updated.
2. In Sec. 1.1.1, added that these coating systems are not intended for immersion service.

V. **Comments.** If you have any comments or questions about this standard, please contact the AWWA Volunteer and Technical Support Group, FAX (303) 795-7603, or write to the group at 6666 West Quincy Avenue, Denver, CO 80235-3098, or by e-mail at standards@awwa.org.



American Water Works
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ANSI/AWWA C218-02
(Revision of ANSI/AWWA C218-99)

AWWA Standard

Coating the Exterior of Aboveground Steel Water Pipelines and Fittings

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes nine coating systems designed to protect the exterior surfaces of steel pipelines and the associated fittings used by the water supply industry in aboveground locations. The coating systems described may not perform or cost the same, but they are presented so that the appropriate coating system can be selected for the site-specific project requirements.

1.1.1 *Conditions not covered in this standard.* The coating systems described in this standard are not intended for underground applications or immersion service, nor are they intended for external pipe surfaces that will be in contact with potable water.

1.1.2 *Maximum temperatures.* The maximum service temperature of the coating systems listed in this standard is based on the maximum service temperature of potable water. Consult the coating manufacturer for conditions and limitations.

Sec. 1.2 Purpose

The purpose of this standard is to define the minimum requirements for coating the exterior of aboveground steel water pipelines and fittings, including coating systems, surface preparation, coating material information requirements, coating application, inspection, and testing.

Sec. 1.3 Application

This standard can be referenced in specifications for coating or recoating the exterior of aboveground steel water pipelines and fittings. The stipulations of this standard apply when this standard has been referenced and then only to coating the exterior of aboveground steel water pipelines and fittings where exterior surfaces are not in contact with potable water.

SECTION 2: REFERENCES

This standard references the following documents. In their latest editions, these documents form a part of this standard to the extent specified within the standard. In any case of conflict, the requirements of this standard shall prevail.

ASTM* D16—Standard Terminology for Paint, Related Coatings, Materials, and Applications.

ASTM D2200—Standard Pictorial Surface Preparation Standards for Painting Steel Surfaces.

ASTM D2794—Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

ASTM D4541—Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

ASTM D5064—Standard Practice for Conducting a Patch Test to Assess Coating Compatibility.

Code of Federal Regulations 29, Labor—Parts 1910, Occupational Safety and Health Administration (OSHA).†

*American Society for Testing and Materials, 100 Barr Harbor Dr., West Conshohocken, PA 19428.

†Available from US Government Printing Office, Superintendent of Documents, Washington, DC 20402.

Fed. Spec. TT-E-489^{*}—Enamel, Alkyd, Gloss (for Exterior and Interior Surfaces).

Fed. Spec. TT-P-320—Pigment, Aluminum: Powder and Paste for Paint.

Fed. Spec. TT-V-81—Varnish; Mixing for Aluminum Paint.

MIL-P-24441^{*}—Paint, Epoxy-Polyamide, General Specification for Metal Surfaces.

MIL-P-28577—Primer, Water-Borne, Acrylic or Modified Acrylic, for Metal Surfaces.

MIL-P-28578—Paint, Water-Borne, Acrylic or Modified Acrylic, Semigloss for Metal Surfaces.

NACE[†] Publication TPC-12—Chemically Cured Coal Tar Coatings for Atmospheric Exposures.

NACE RP0188—Discontinuity (Holiday) Testing of Protective Coatings.

SSPC[‡]—Painting Manual, Vol. 2, Systems and Specifications.

SSPC-PA 1—Paint Application Specification No. 1, Shop, Field, and Maintenance Painting.

SSPC-PA 2—Paint Application Specification No. 2, Measurement of Dry Paint Thickness with Magnetic Gages.

SSPC-Paint 20—Paint Specification No. 20, Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic).

SSPC-Paint 21—Paint Specification No. 21, White or Colored Silicone-Alkyd Paint Type I, High Gloss Type II, Medium Gloss.

SSPC-Paint 25—Paint Specification No. 25, Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments).

SSPC-Paint 101—Paint Specification No. 101, Aluminum Alkyd Paint Leafing (Type I) and Non-Leafing (Type II).

SSPC-Paint 104—Paint Specification No. 104, White or Tinted Alkyd Paint.

SSPC-PS Guide 17.00—Painting System Guide No. 17.00, Guide for Selecting Urethane Paint Systems.

^{*}US Government Defense Printing Service Detachment Office, Customer Service, Bldg. 4D, 700 Robbins Ave., Philadelphia, PA 19111.

[†]NACE International, 1440 S. Creek Dr., Houston, TX 77084.

[‡]SSPC: The Society for Protective Coatings, 40 24th St., Sixth Floor, Pittsburgh, PA 15222.

SSPC-SP COM—Surface Preparation Specifications, Surface Preparation Commentary.

SSPC-SP 1—Surface Preparation Specification No. 1, Solvent Cleaning.

SSPC-SP 2—Surface Preparation Specification No. 2, Hand Tool Cleaning.

SSPC-SP 3—Surface Preparation Specification No. 3, Power Tool Cleaning.

SSPC-SP 10/NACE No. 2, Near-White Blast Cleaning.

SSPC-VIS 3—Visual Standard for Power and Hand-Tool Cleaned Steel.

SECTION 3: DEFINITIONS

The following definitions shall apply in this standard:

1. *Blast cleaning:* Blast cleaning with sand, mineral slag, steel shot, or grit.
2. *Constructor:* The party that provides the work and materials for placement or installation.
3. *Manufacturer:* The party that manufactures, fabricates, or produces materials or products.
4. *Purchaser:* The person, company, or organization that purchases any materials or work to be performed.

SECTION 4: REQUIREMENTS

Sec. 4.1 Materials

Coating materials shall be manufactured in accordance with the appropriate reference standards.

Sec. 4.2 Coating Systems

4.2.1 *General.* The nine coating systems described in this standard are summarized in Table 1.* The primer, intermediate coat (where used), and the finish coat shall be obtained from the same manufacturer. The name, address, and telephone number of the company that manufactures the coating shall be supplied.

*In Table 1 and throughout this standard, direct metric conversions (rounded) are set in parentheses next to US Customary units and are not necessarily the same as those listed in International Organization for Standardization (ISO) standards.

Table 1 Summary of coating systems for the exterior surfaces of aboveground steel pipe and fittings

Designation	System Description	Total System Dry Film	Minimum Thickness
		<i>mil</i>	<i>μm</i>
1	Three-coat alkyd	3.5/4.5*	(88/114)
2	Four-coat alkyd	5.0/6.0*	(126/152)
3	Three-coat alkyd/silicone alkyd	4.5	(114)
4	Three-coat epoxy/urethane	7.5	(191)
5	Three-coat inorganic or organic zinc/epoxy/urethane	7.0	(178)
6	Two- or three-coat epoxy/coal-tar epoxy	14.0	(355)
7	Two- or three-coat water reducible epoxy-polyamid	8.0	(203)
8	Three-coat water reducible acrylic or alkyd-modified acrylic emulsion	8.0	(203)
9	Two- or three-coat epoxy/high-build aliphatic polyurethane over existing coated substrates	10.0/15.0	(254/381)

*See Sec. 4.2.2.2 and 4.2.3.2

When a coating or coating system described in this standard is referenced to federal, military, or other referenced standards, the reference phrase “comparable in performance to” shall mean that a proprietary coating or coating system will provide equal service when it is subjected to the equivalent service conditions for the same length of time as the referenced coating or coating system. The manufacturer shall provide documentation consisting of laboratory test data or field service data demonstrating that the proposed proprietary coating or coating system is equivalent to the referenced standard.

4.2.2 Coating System No. 1. This is a three-coat alkyd system consisting of a prime coat of a rust-inhibitive, pigmented alkyd primer followed by two coats of alkyd enamel. The following coating systems are included:

System Designation	Intermediate and Finish Coats
1-A	Aluminum
1-W	White
1-S	Special color specified

4.2.2.1 **Materials.** The prime coat shall contain rust-inhibitive pigments to provide performance comparable to SSPC-Paint 25 and shall be compounded with alkyd resin and raw linseed oil similar to SSPC-Paint 25.

For System 1-A, the intermediate and finish coats shall be either (1) job-mixed alkyd aluminum in accordance with SSPC-Paint 101; or (2) ready-mixed aluminum coating consisting of aluminum paste in accordance with Federal Specification TT-P-320, Type II, Class B. The varnish shall be mixed in accordance with Federal Specification TT-V-81, Type II in the proportion of 2 lb of aluminum paste per gal (0.23 kg/L) of mixing varnish.

For System 1-W, the intermediate and finish coats shall be white alkyd enamel comparable in performance to SSPC-Paint 104, Type I.

For System 1-S, the intermediate and finish coats shall be gloss alkyd enamel comparable in performance to Federal Specification TT-E-489.

4.2.2.2 **Thickness.** Minimum dry film thickness (DFT) of the coating system shall be as follows:

System	Primer 1		Intermediate Coat		Finish Coat		Total System	
	mil	(μm)	mil	(μm)	mil	(μm)	mil	(μm)
1-A	1.5	(38)	1.0	(25)	1.0	(25)	3.5	(88)
1-W	1.5	(38)	1.5	(38)	1.5	(38)	4.5	(114)
1-S	1.5	(38)	1.5	(38)	1.5	(38)	4.5	(114)

4.2.3 **Coating System No. 2.** This is a four-coat alkyd system consisting of two prime coats of rust-inhibitive, pigmented alkyd primer followed by two coats of alkyd enamel. The following coating systems are included:

System Designation	Intermediate and Finish Coats
2-A	Aluminum
2-W	White
2-S	Special color specified

4.2.3.1 **Materials.** The prime coat shall contain rust-inhibitive pigments to provide performance comparable to SSPC-Paint 25 and shall be compounded with

alkyd resin and raw linseed oil similar to SSPC-Paint 25. This primer shall be compatible with the specified coating system.

For System 2-A, the intermediate and finish coats shall be either (1) job-mixed alkyd aluminum coating in accordance with SSPC-Paint 101; or (2) ready-mixed aluminum coating consisting of aluminum paste in accordance with Federal Specification TT-P-320, Type II, Class B. The varnish shall be mixed in accordance with Federal Specification TT-V-81, Type II, in the proportion of 2 lb of aluminum paste per gal (0.23 kg/L) of mixing varnish.

For System 2-W, the intermediate and finish coats shall be white alkyd enamel comparable in performance to SSPC-Paint 104, Type I.

For System 2-S, the intermediate and finish coats shall be gloss alkyd enamel comparable in performance to Federal Specification TT-E-489.

4.2.3.2 Thickness. Minimum DFT of the coating system shall be as follows:

System	Primer 1		Primer 2		Intermediate Coat		Finish Coat		Total System	
	mil	(μm)	mil	(μm)	mil	(μm)	mil	(μm)	mil	(μm)
2-A	1.5	(38)	1.5	(38)	1.0	(25)	1.0	(25)	5.0	(126)
2-W	1.5	(38)	1.5	(38)	1.5	(38)	1.5	(38)	6.0	(152)
2-S	1.5	(38)	1.5	(38)	1.5	(38)	1.5	(38)	6.0	(152)

4.2.4 *Coating System No. 3.* This is a three-coat system consisting of a prime coat of rust-inhibitive, pigmented alkyd primer followed by an alkyd resin intermediate coat and a finish coat of silicone-alkyd. The following coating systems are included:

System Designation	Intermediate and Finish Coats
3-W	White
3-S	Special color specified

4.2.4.1 Materials. The prime coat shall contain rust-inhibitive pigments formulated to provide performance comparable to SSPC-Paint 25 and shall be compounded with alkyd resin and raw linseed oil similar to SSPC-Paint 25. This primer shall be compatible with the specified coating system. Two prime coats may also be used for this system, making it similar to System 2.

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The material for the intermediate coat shall be an alkyd enamel comparable in performance to SSPC-Paint 104, Type I; SSPC-Paint 104, Type II (medium to light gray to tan paint); or Type III (light green to gray-green paint), which may be used with System 3-S depending on the finish coat color.

For System 3-W, the finish coat shall be a white silicone-alkyd paint in accordance with SSPC-Paint 21, Type I or Type II.

For System 3-S, the finish coat shall be a silicone-alkyd paint in accordance with SSPC-Paint 21, Type I or Type II, with an appropriate pigment color.

4.2.4.2 Thickness. Minimum DFT of the coating system shall be as follows:

System	Primer 1		Intermediate Coat		Finish Coat		Total System	
	mil	(μm)	mil	(μm)	mil	(μm)	mil	(μm)
3-W	1.5	(38)	1.5	(38)	1.5	(38)	4.5	(114)
3-S	1.5	(38)	1.5	(38)	1.5	(38)	4.5	(114)

4.2.5 *Coating System No. 4.* This is a three-coat system consisting of a prime coat of two-component, rust-inhibitive, pigmented, catalyzed epoxy primer followed by an intermediate coat of catalyzed epoxy with a finish coat of a two-component aliphatic polyurethane as described in ASTM D16 and SSPC-PS Guide 17.00.

System Designation	Intermediate and Finish Coats
4-W	White
4-S	Special color specified

4.2.5.1 Materials. The prime and intermediate coats shall be a two-component catalyzed epoxy comparable in performance to MIL-P-24441 applied at a DFT described in Sec. 4.2.5.2. The intermediate coat shall be tinted one shade different from the finish color.

For System 4-W or System 4-S, the finish coat shall be two-component aliphatic polyurethane comparable in performance to SSPC-PS Guide 17.00.

4.2.5.2 Thickness. Minimum DFT of the coating system shall be as follows:

System	Primer 1		Intermediate Coat		Finish Coat		Total System	
	mil	(μm)	mil	(μm)	mil	(μm)	mil	(μm)
4-W	2.0	(51)	4.0	(102)	1.5	(38)	7.5	(191)
4-S	2.0	(51)	4.0	(102)	1.5	(38)	7.5	(191)

NOTE: Brush or roller applications may require an additional coat to attain the specified thickness.

4.2.6 *Coating System No. 5.* This is a combination of an inorganic or organic zinc/epoxy/urethane system. It consists of a shop-applied, inorganic or organic zinc-rich primer and a touch-up coat of organic zinc-rich primer or epoxy primer applied in the field to repair coating damage. The epoxy intermediate and aliphatic urethane finish coatings are then field-applied.

System Designation	Intermediate and Finish Coats
5-W	White
5-S	Special color specified

4.2.6.1 *Materials.* The prime coat shall be an inorganic or organic zinc-rich primer comparable in performance to SSPC-Paint 20 (Type I, Inorganic, or Type II, Organic). The field-applied, touch-up coat shall be applied as necessary and shall be organic zinc-rich primer comparable in performance to SSPC-Paint 20 (Type II, Organic) or an epoxy primer comparable in performance to MIL-P-24441 that is applied at a DFT as described in Sec. 4.2.6.2.

The intermediate coat shall be a two-component epoxy coating comparable in performance to MIL-P-24441 that is applied to a DFT as described in Sec. 4.2.6.2 and tinted one shade different from the finish color.

For System 5-W or System 5-S, the finish coat shall be a two-component aliphatic polyurethane meeting the requirements of ASTM D16, Type V, and shall be comparable in performance to SSPC-PS Guide 17.00, Type V.

4.2.6.2 Thickness. Minimum DFT of the coating system shall be as follows:

System	Primer 1		Intermediate Coat		Finish Coat		Total System	
	mil	(μm)	mil	(μm)	mil	(μm)	mil	(μm)
5-W	2.5	(64)	3.0	(76)	1.5	(38)	7.0	(178)
5-S	2.5	(64)	3.0	(76)	1.5	(38)	7.0	(178)

4.2.7 *Coating System No. 6.* This is a two- or three-coat system consisting of a prime coat of a two-component, rust-inhibitive, pigmented, catalyzed epoxy primer followed by one or two coats of a catalyzed coal-tar epoxy coating. The following coating system is included:

System Designation	Intermediate and Finish Coats
6-B	Black

4.2.7.1 Materials. The prime coat shall be a two-component, catalyzed, rust-inhibitive pigmented epoxy comparable in performance to MIL-P-24441 that is applied at a DFT as described in Sec. 4.2.7.2. The intermediate or finish coat shall be a catalyzed coal-tar epoxy comparable to those described in NACE Publication TPC-12.

A colored epoxy topcoat or a colored topcoat that develops intercoat adhesion to the coal-tar epoxy may be applied for safety, aesthetics, or longevity to an aged and weathered coal-tar epoxy film. Some discoloration may occur because of color bleed-through, especially white or light-colored paints. This discoloration of the topcoat does not indicate a failure of the coating system.

4.2.7.2 Thickness. Minimum DFT of the coating system shall be as follows:

System	Primer		One-Coat High-Build Coal-Tar Epoxy		or	Two-Coat Coal-Tar Epoxy (Per Coat)		Total System	
	mil	(μm)	mil	(μm)		mil	(μm)	mil	(μm)
6-B	2.0	(51)	12.0	(304)		6.0	(152)	14.0	(355)

4.2.8 *Coating System No. 7.* This is a two- or three-coat system consisting of a water-reducible prime coat of a two-component, rust-inhibitive, pigmented, catalyzed epoxy primer followed by one or two coats of a two-component,

water-reducible epoxy-polyamide coating. The following coating systems are included:

System Designation	Intermediate and Finish Coats
7-W	White
7-S	Special color specified

4.2.8.1 Materials. The prime coat shall be a water-reducible, rust-inhibitive, pigmented, catalyzed epoxy primer comparable in performance to MIL-P-24441 that is applied at a DFT as described in Sec. 4.2.8.2.

For System 7-W or System 7-S, the intermediate and finish coats shall be a water-reducible epoxy coating comparable in performance to MIL-P-24441 that is applied at a DFT described in Sec. 4.2.8.2. The first of two topcoats shall be tinted one shade different from the finish color.

4.2.8.2 Thickness. Minimum DFT of the coating system shall be as follows:

System	Primer		One-Coat High-Build Epoxy		or	Two-Coat Epoxy (Per Coat)		Total System	
	mil	(μm)	mil	(μm)		mil	(μm)	mil	(μm)
7-W	2.0	(51)	6.0	(152)		3.0	(76)	8.0	(203)
7-S	2.0	(51)	6.0	(152)		3.0	(76)	8.0	(203)

4.2.9 Coating System No. 8. This is a three-coat, water-reducible, industrial-type acrylic or alkyd-modified acrylic emulsion coating system consisting of a rust-inhibitive, pigmented, single-component, water-reducible primer followed by two coats of a single-component, water-reducible, industrial-type acrylic or alkyd-modified acrylic emulsion finish coat. On weathered and slightly chalked films, the alkyd-modified acrylic emulsion coating should be specified to obtain better adhesion between the weathered, chalked coat and the finish coat. The following coating systems are included:

System Designation	Intermediate and Finish Coats
8-W	White
8-S	Special color specified

4.2.9.1 **Materials.** The prime coat shall be an industrial-type acrylic emulsion coating containing rust-inhibitive pigments to provide performance comparable to MIL-P-28577. The prime coat shall be compatible with the topcoat.

For System 8-W or System 8-S, the finish coat shall be a single-component, water-reducible, industrial-type acrylic or alkyd-modified acrylic emulsion coating comparable in performance to MIL-P-28578. The first of the two topcoats shall be tinted one shade different from the finish color.

4.2.9.2 **Thickness.** Minimum DFT of the coating system shall be as follows:

System	Primer 1		Intermediate Coat		Finish Coat		Total System	
	mil	(μm)	mil	(μm)	mil	(μm)	mil	(μm)
8-W	2.0	(51)	3.0	(76)	3.0	(76)	8.0	(203)
8-S	2.0	(51)	3.0	(76)	3.0	(76)	8.0	(203)

4.2.10 **Coating System No. 9.** This is a two- or three-coat epoxy-mastic/high-build, aliphatic polyurethane coating system consisting of a prime coat of surface-tolerant epoxy mastic followed by a coat of high-build polyurethane topcoat. This multicoat system is intended to be applied in the field over an existing coating that is tightly adhered to the steel substrate. The existing coating should be sufficiently cohesive and adhesive to allow the adhesion of the epoxy-mastic tie coat. Areas where bare, rusty metal is exposed shall be cleaned with a hand-tool or power-tool in accordance with SSPC-SP 2 or SSPC-SP 3. Edges of existing coatings shall be feathered to form a smooth transition followed with a spot prime coat of epoxy mastic at a DFT of 5 mil (127 μm). Following the spot priming, a full coat of epoxy mastic with a high-build aliphatic polyurethane topcoat shall be applied.

The preferred surface preparation of the tight-adhering, existing coating is to use a 6,000-psi (41.37-MPa), 5- to 10-gpm (19- to 38-L/m) water blast. This method will remove dirt, paint chalk, loose paint, salts, and other contaminants from the surface of the tight-adherent paint. If water blasting cannot be used, then SSPC-SP 2 or SSPC-SP 3 methods shall be used to clean the surface of the paint. Any areas where the paint has been removed shall be spot primed. The surface shall be allowed to dry prior to spot priming. After cleaning the surface of the tight-adhering paint and after applying the spot primer where necessary, a full coat of epoxy mastic with a polyurethane topcoat shall be applied.

This surface-tolerant coating system is not recommended for application over lacquer-type coating systems, such as acrylics, chlorinated rubbers, vinyls, latexes, and similar coating systems. Surface-tolerant coating systems are recommended for use over aged alkyds, epoxies, and similar paint and coating systems. The following coating systems are included:

System Designation	Intermediate and Finish Coats
9-W	White
9-S	Special color specified

4.2.10.1 Materials. The prime coat shall be a two-component epoxy-mastic primer. The epoxy-mastic tie coat shall be a two-component, epoxy-mastic coating tinted one shade different from the finish color. For System 9-W or System 9-S, the finish coat shall be a two-component, high-build aliphatic polyurethane meeting the requirements of ASTM D16, Type V, and shall be comparable in performance to SSPC-PS Guide 17.00, Type V.

4.2.10.2 Thickness. Minimum DFT of the coating system shall be as follows:

System	Primer		Tie Coat		Finish Coat		Total System without Primer		Total System with Primer	
	mil	(μm)	mil	(μm)	mil	(μm)	mil	(μm)	mil	(μm)
9-W	5.0	(127)	5.0	(127)	5.0	(127)	10.0	(254)	15	(381)
9-S	5.0	(127)	5.0	(127)	5.0	(127)	10.0	(254)	15	(381)

NOTE: It is recommended that the total system without primer applied over the tightly adherent paint not exceed 14 dry mil (356 μm). Total system with primer over bare steel should not exceed 20 dry mil (508 μm). It is highly recommended that an adhesion (compatibility) test patch of the surface-tolerant coating system be applied and evaluated after curing in accordance with ASTM D5064.

The epoxy mastic and polyurethane should be applied by brush, roller, or spray. Additional coats may be necessary if applied by brush or roller to achieve required film thicknesses.

Sec. 4.3 Coating Material Information Requirements

4.3.1 *Labels.* The containers in which the painting materials are delivered shall be marked with the manufacturer's name, distinctive product name or number, lot number, safety precautions, and all other information required by all applicable codes and regulations.

4.3.2 *Product information.* Product information shall be provided by the manufacturer for each product. The product information shall be printed on the label or provided in a technical data sheet and shall include the following.

4.3.2.1 *Mixing instructions.* Complete mixing instructions, including acceptable thinning materials, acceptable tinting pigments (when applicable), and the identification of components shipped in separate containers.

4.3.2.2 *Thinning.* The quantity limits, quality, and type of thinner recommended for each method of application shall be provided by the manufacturer. Thinning recommendations shall cover the extreme limits of the allowable temperature range for application, as well as intermediate temperatures. The viscosity of liquid materials shall be indicated in units appropriate for field determination. Instruments, such as the Zahn cup, should be used to take viscosity measurements in the field.

4.3.2.3 *Percent solids.* The percent solids by volume for liquid materials shall be provided by the manufacturer.

4.3.2.4 *Spreading rate.* The theoretical spreading rate in square feet per gallon at (square meters per liter) 1-mil (25- μ m) DFT or at the specified applied DFT shall be provided by the manufacturer. Unless otherwise specified, the thickness of the coating system shall be verified in accordance with SSPC-PA 2.

4.3.2.5 *Weight.* The net weight in lb/gal (kg/L) of liquid materials and the net weight of the total contents of a container for other materials shall be provided by the manufacturer. These weights, if not found on labels or technical data sheets, shall be provided when requested by the purchaser.

4.3.2.6 *Drying time.* The time for drying and curing shall be stated as the number of hours at 70°F (21°C) and 50 percent relative humidity. The upper and lower limits of the recommended application temperature, dew point, and relative humidity also shall be indicated.

4.3.2.7 *Pot life.* The pot life, after mixing, of the components of multicomponent coatings shall be stated together with a description of variations caused by changes in temperature, humidity, or other ambient conditions.

4.3.2.8 Shelf life. A shelf-life time period for the product use shall be given.

4.3.2.9 Safety precautions. Flammability, toxicity, allergenic properties, and any other characteristic requiring field precautions by personnel shall be identified, and specific safety practices shall be stipulated, as required by all applicable codes and regulations.

Sec. 4.4 Surface Preparation

4.4.1 *Surface condition.*

4.4.1.1 Coating new pipe. The surfaces to be coated shall be free from mud, mill lacquer, wax, coal tar, asphalt, oil, grease, or any other foreign material. Before blast cleaning, the surfaces shall be inspected and, if required, precleaned according to SSPC-SP 1 to remove oil, grease, and loosely adhering deposits. Visible oil and grease spots shall be removed using a solvent. Only safety solvents that do not leave a residue shall be used. Heating may be used to remove oil, grease, mill scale, water, and ice, provided the pipe section, fitting, or special is preheated in a uniform manner to avoid distortion. Heated pipe sections, fittings, or specials shall be allowed to cool within a temperature range acceptable to the manufacturer for the application of the coating.

4.4.1.2 Previously coated piping. Where a pipeline is to be repainted, the existing type of paint and surface condition shall be determined and recommendations obtained from the manufacturers of new paint systems regarding the surface preparation requirements. Based on the paint system selected, the project specifications shall stipulate (1) how the surface of the old paint shall be prepared, (2) how much of the old paint must be removed, and (3) if repriming is required, the surface preparation necessary based on the adhesion and performance compatibilities of the manufacturer's coating system.

4.4.2 *Blast cleaning.* The surfaces to be coated shall be blast cleaned to achieve a surface conforming to the manufacturer's recommendations. However, many two-component coatings require a near-white surface conforming to SSPC-SP 10/NACE No. 2 after preheating the pipe to a sufficient temperature to remove all moisture. For the purposes of this standard, near-white blast cleaning means that all metal surfaces shall be cleaned to remove all dirt, dust, mill scale, rust, corrosion products, oxides, paint, and other foreign matter. Very light shadows, very slight streaks, or slight discolorations shall be acceptable; however, at least 95 percent of

each square inch (square centimeter) of the surface shall have the uniform gray appearance of a white metal, blast-cleaned surface.

4.4.2.1 Visual comparative standards. Before full-scale blast cleaning is started, a representative area of the work surface and the surface of 6-in. × 6-in. × 1/4-in. (152-mm × 152-mm × 6.4-mm) steel panels shall be blast cleaned for use as visual comparative standards. When the visual standard meets the requirements of Sec. 4.4.2, the panels shall be wrapped in heavy-gauge plastic and sealed with tape or otherwise protected from surface contamination or corrosion. The panels shall be maintained as visual reference standards throughout the coating operations. Extreme care shall be used in sealing the reference panels, as they will rust when exposed to moisture. Other industry-accepted, agreed-on visual comparative standards may be used (e.g., ASTM D2200 or SSPC-VIS 3).

4.4.2.2 Abrasive working mix. For consistent surface cleanliness and profile, an abrasive working mix shall be maintained in the abrasive recycling blasting machines by frequent, small additions of new grit or shot commensurate with abrasive consumption; infrequent large additions shall be avoided. The abrasive working mix in abrasive recycling blasting machines shall be maintained free from contaminants by continuous, effective operation of the blasting machines' scalping and air-wash separators.

4.4.2.3 Surface profile. The cleaning abrasive shall be selected according to SSPC-SP COM to achieve a surface anchor pattern or profile of 1.5 mil (38 μm) to 4.0 mil (100 μm). The upper and lower limits of the anchor pattern or profile shall be determined by the system specified and shall comply with the manufacturer's recommendations.

4.4.3 *Surface inspection.* The cleaned surfaces shall be inspected for surface preparation. Surface imperfections, such as slivers, scabs, burrs, weld spatter, and gouges, shall be removed by hand filing or grinding.

4.4.4 *Protection from moisture.* Blast-cleaned surfaces shall be protected from high humidity, rainfall, or surface moisture. No surface shall be allowed to flash rust before coating.

Sec. 4.5 Coating Application

4.5.1 *General.* The storage of coating and thinner, mixing, thinning, coating contact surfaces, application of shop and field coats, and drying of coated steel piping shall follow the requirements of SSPC-PA 1.

4.5.2 Materials preparation. Each component of the coating system shall be thoroughly stirred before mixing. If the components are packaged proportionately to their mixing ratio, the entire contents of the smaller container should be added to the larger container. For components not packaged proportionately, the ratio recommended by the manufacturer shall be used. Only the material used within its pot life shall be mixed. The components should be mixed vigorously for at least 2 min using a power agitator and longer if recommended by the manufacturer. Other recommendations of the manufacturer regarding “sweat-in” or “digestion” time after mixing shall be followed.

4.5.3 Pipe ends. Pipe sections with beveled- or lap-joint ends to be joined by field welding shall not be coated within 2 to 6 in. (51 to 152 mm) of the area to be welded. Coating material on the cutback, bevel, or band is not acceptable. When rubber-gasketed bell and spigot joints or mechanical couplings are used, the coating may extend to the ends of the pipe; but the coating thickness on the pipe surfaces that receive the rubber sealing gaskets shall not exceed the recommended thickness by the manufacturer of the coupling for mechanical coupled joints or the pipe manufacturer for rubber-gasketed bell and spigot joints. However, the maximum DFT shall not be less than that listed for the coating system selected.

4.5.4 Application temperature. The temperature of the mixed coatings and of the pipe at the time of application shall not be lower than 50°F (10°C), unless otherwise permitted by the manufacturer. In-line heaters to heat the coating, pipe, fittings, or specials may be used to facilitate the application and curing of the coating. The manufacturer should be consulted for specific heating information.

4.5.5 Prime coat. Coating materials shall be applied immediately after surface preparation and before any surface rusting occurs or any dust or soil has accumulated. Shop-applied prime coats may be applied by any method that provides an acceptable coating. Field priming shall be performed by brushing, rolling, or spraying.

When piping has been shop-primed, all weld areas and areas on which shop primer has been damaged shall be cleaned in the field and primed with the same primer. The primer shall be applied to the same DFT as the shop coat. When an inorganic zinc-rich primer has been used as the shop primer, another system-compatible primer may be applied in the field to the damaged areas.

4.5.6 *Intermediate and finish coats.* Surfaces shall be spray coated, using a method recommended by the coating manufacturer, such as conventional or airless spray. Brushing may be used if recommended by the manufacturer.

4.5.7 *Application of coating system.* The coating system shall be applied as recommended by the manufacturer. If more than one coat is applied, the second coat shall be applied within time limits recommended by the manufacturer to prevent delamination between coats. If the recommended period between coats is exceeded, a recommended repair procedure shall be obtained from the manufacturer. When measured according to SSPC-PA 2, the total DFT of the coating system shall not be less than the minimum specified in Sec. 4.2. The maximum DFT shall not exceed the manufacturer's recommendations.

4.5.8 *Cure.* After the coating system is applied, it shall be cured in accordance with the manufacturer's recommendations.

4.5.9 *Imperfections.* The coating system shall not have blisters, cracks, bubbles, under-film voids, mechanical damage, holidays, pinholes, or discontinuities. If holiday testing is specified, then inspection shall be performed in accordance with NACE RP0188.

4.5.10 *Coating repair.*

4.5.10.1 *Defects.* Coating requiring repair because of scabs, slivers, coating imperfections, and other defects shall be repaired in accordance with the following subsections.

4.5.10.1.1 Surfaces requiring coating repairs shall be cleaned to remove dirt, scale, and damaged coating using surface grinders or other means approved by the purchaser. The adjacent coating shall be feathered by sanding or tool-cleaned per SSPC-SP 2 or SSPC-SP 3. Accumulated dust shall be removed by wiping with clean rags.

4.5.10.1.2 The coating system shall be applied to the prepared repair areas in accordance with the procedures described in Sec. 4.5.2 and Sec. 4.5.4 through 4.5.8.

4.5.11 *Welded field joints.*

4.5.11.1 *Preparation.* On exterior pipe surfaces, the welded joint shall be cleaned of mud, oil, grease, welding flux, weld spatter, and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be abrasive-blasted, vacuum-blasted, or abraded using rotary abrading pads to a near-white metal finish per SSPC-SP 10/NACE No. 2. The adjacent coating shall be

feathered by sanding to clean and roughen the coating surface for a minimum distance of 1 in. (25 mm).

4.5.11.2 Coating application. The coating system shall be applied to the weld joint in accordance with Sec. 4.5.2 and Sec. 4.5.4 through 4.5.8.

4.5.12 *Coating special pipe fittings and appurtenances.* This section describes the application of coatings to mechanical couplings, flanges, and similar appurtenances for steel pipe fittings and specials, as well as to nuts, bolts, and other items used with fittings and attachments.

4.5.12.1 Surface preparation. Surfaces of pipe fittings and appurtenances to be coated shall be prepared in accordance with Sec. 4.4.

4.5.12.2 Coating application. Coatings shall be applied in accordance with Sec. 4.5.

4.5.12.3 Threaded connections and flange faces. The threads of mechanically threaded connections that must be assembled in the field shall be left uncoated. If specified, the threads on threaded connections may be coated with rust-preventing oil applied to the threads only. Before final field assembly, the oil shall be removed with a cleaning solvent. After joining, the remaining exposed threads shall be coated as described in Sec. 4.5. Flange faces and similar mating surfaces of other mechanical connections shall also be coated with rust-preventing oil.

4.5.12.4 Cure. After the coating is applied, it shall be cured in accordance with the manufacturer's recommendations.

4.5.12.5 Imperfections. Once the coating application is completed, the coating system shall be visually inspected as specified in Sec. 4.5.9.

4.5.12.6 Coating repair. Imperfections detected by visual inspection shall be repaired in accordance with Sec. 4.5.10.

Sec. 4.6 Safety Precautions

4.6.1 *General.* Ventilation, electrical grounding, and care in handling paint, solvents, and equipment are important safety precautions when painting steel piping. All work associated with surface preparation and coating the pipe shall be in accordance with all applicable codes and regulations.

4.6.2 *Ventilation in confined areas.* Where exposed steel piping is located in a confined area, it is essential that solvent vapors released during and after the application of coatings be removed from the area. During the coating application, the capacity of ventilating fans used in removing the solvent vapors shall be a minimum

of 300 cfm per gal (37.4 L/s per litre) of coating applied per hour, or as required by applicable local standards.

4.6.3 *Grounding.* Precautions must be taken during blast cleaning and painting operations to prevent the accumulation of static electricity.

Sec. 4.7 Field Procedures

At all times during construction, every precaution shall be used to prevent damage to the protective coating on the pipe. No metal tools or heavy objects shall be permitted to come into contact with the finished coating. Workers shall not be permitted to walk on the coating except when absolutely necessary, in which case they shall wear shoes with rubber or composition soles and heels or other suitable footwear that will not damage the coating. Any damage to the pipe or the protective coating during installation and before final acceptance shall be repaired or replaced as directed by the purchaser by and at the expense of the constructor. Any coating damage shall be repaired in accordance with Sec. 4.5.10.

4.7.1 *Protection during welding.* An 18-in. (450-mm) wide strip of heat-resistant material shall be draped over the pipe on each side of the coating holdback during welding to avoid damage to the coating by weld spatter. To prevent coating damage, no welding ground shall be attached to the coated part of the pipe.

4.7.2 *Hoisting.* Pipe shall be hoisted using wide belt slings. Metal chains, cables, tongs, or other equipment likely to cause damage to the coating will not be permitted; nor will dragging or skidding of the pipe be permitted. Inspection of the coating on the underside of the pipe while suspended from the slings or lifting lugs shall be allowed.

SECTION 5: VERIFICATION

Sec. 5.1 Inspection

5.1.1 *Overall inspection.* At the purchaser's request, the entire procedure of applying the coating system described in this standard may be inspected from the time the surface is prepared to the time the coating application is completed. This inspection shall not relieve the constructor of the responsibility to provide the material and work performance compliant with this standard.

5.1.2 *Access for purchaser.* The purchaser shall have complete access to the construction site and the areas of the plants engaged in performing the work in this standard.

5.1.3 *Facilities for purchaser.* The constructor shall provide the purchaser with facilities and space for the inspection, testing, and obtaining of such information as desired by the purchaser regarding the material used, the application, progress, and manner of the work, and the results obtained.

Sec. 5.2 Testing

5.2.1 *Coating material tests.* Prior to acceptance of the constructor's coating materials, samples of the coating material may be tested by the purchaser in the purchaser's laboratory or in an independent commercial laboratory designated by the purchaser. If any samples fail to conform to the standard, additional samples may be tested.

5.2.2 *Preparation of test panels.* Hot- or cold-rolled, 4-in. × 6-in. × 1/8-in. (100-mm × 150-mm × 3.2-mm) steel panels shall be prepared by blast cleaning one side in accordance with Sec. 4.4.2. The coating shall be applied with or without primer, depending on the coating system and at the thickness and by the method recommended by the manufacturer. The coating shall be cured according to the manufacturer's recommendations before conducting the materials tests.

5.2.3 *Impact resistance.* Three steel panels shall be prepared, coated, and cured as described in Sec. 5.2.2. Intrusion (direct impact) or extrusion (reverse impact) tests shall be performed in accordance with ASTM D2794. Test results shall not be less than the minimum value established by the manufacturer.

5.2.4 *Adhesion.* Adhesion tests shall be performed only after the coating system has cured in accordance with the manufacturer's recommendations. The manufacturer should be consulted for a curing schedule.

5.2.4.1 *Adhesion test procedure.* The adhesion or bond of the coating to the steel and the intercoat adhesion of the several coats after curing shall be determined in the field by making a V-shaped cut through the coating with a sharp knife. The adhesion will be successful if the film cannot be peeled by the knife either from the steel or between the coats. Forcible rupture of the coating leaving portions of the film adhering tightly to the metal shall not cause the rejection of the coating. The area removed from where the cut intersects to form the "V" shall be no greater than 0.125 in. (3.0 mm). Alternatively, the testing for adhesion of the coating to the test

panel can be performed in the laboratory in accordance with ASTM D4541. This test may also be performed in the field under the conditions specified in the ASTM D4541 test procedure. ASTM D4541 may not be suitable for testing to determine the adhesion of alkyds or their systems, because the adhesive used in the test could damage the coating.

Sec. 5.3 Rejection

5.3.1 *Surface preparation and coating application.* The purchaser may reject the surface preparation, coated pipe, or fittings if the surface condition or application of the coating does not comply with the requirements of Sec. 4.4 and 4.5. Pipe rejected because of inadequate cleaning shall be recleaned and recoated.

5.3.2 *Coating materials.* If any sample of coating materials does not comply with this standard, then all coating material represented by the sample shall be rejected. If samples of the constructor's coating materials that have been previously accepted do not conform to this standard, then these coating materials shall be rejected.

SECTION 6: DELIVERY

Sec. 6.1 Handling and Storage

Coated pipe, fittings, and special sections shall be handled, stored, and shipped in a manner to prevent damage to the coating. Pipe shall be handled and stored in a manner that prevents damage to pipe walls and ends. Pipe or coating damaged in handling or other operations shall be replaced or repaired. Damage to the external coating shall be repaired in accordance with Sec. 4.5.10. Handling during coating and curing shall be conducted in a manner that prevents damage to the coating.

6.1.1 *Stacking.* Stacking shall be in accordance with safety protocols and in accordance with the project specifications. Sufficient spacers or padding shall be used to prevent damage to the coated pipe and fittings.

6.1.2 *Shipping.* Pipe and fittings shall be transported from the coating yard to the jobsite using sufficient shoring or dunnage, padding, and banding to protect the pipe and its coating.

6.1.3 *Loading.* Pipe and fittings shall be loaded for shipping in compliance with existing shipping standards and regulations.

Sec. 6.2 Packaging and Marking

6.2.1 *Packaging.* The coating purchased or used in this standard shall be packaged in containers that are 1 gal (3.8 L), 5 gal (19 L), or 55 gal (210 L) in volume.

6.2.2 *Marking.* The coating containers shall be plainly marked with the name of the manufacturer, type of materials, batch or lot number, date of manufacture, storage conditions, and information as required by federal and state laws.

Sec. 6.3 Affidavit of Compliance

An affidavit that the work and materials provided meet the applicable requirements of this standard may be required, if specified.

Not for Resale

AWWA is the authoritative resource for knowledge, information and advocacy to improve the quality and supply of drinking water in North America and beyond. AWWA is the largest organization of water professionals in the world. AWWA advances public health, safety and welfare by uniting the efforts of the full spectrum of the drinking water community. Through our collective strength we become better stewards of water for the greatest good of the people and the environment.

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