SSPC: The Society for Protective Coatings

SSPC-Paint 20

Zinc-Rich Coating Type I – Inorganic and Type II – Organic

1. Scope

1.1 This specification covers two types of highly pigmented zinc-rich coatings that are uniquely defined by their capabilities for protecting steel exposed at film discontinuities such as narrow scratches and holidays.

1.2 The vehicle type may be inorganic (Type I) or organic (Type II).

1.3 This specification does not cover weldable preconstruction primers such as SSPC-Paint 30.

1.4 Zinc-rich coatings, both topcoated and untopcoated, have been used successfully in a wide variety of environmental zones. For a detailed breakdown of applicability of various types of zinc-rich coatings in different environmental zones, refer to SSPC-PS Guide 12.00. Consult the coating manufacturer for specific exposure recommendations (see Note 12.1).

1.5 This coating is intended for application by spray for use by itself or as a primer in a multi-coat system.

2. Description

2.1 USE OF SPECIFICATION

2.1.1 Primers meeting this specification are categorized according to vehicle type and zinc level.

2.1.2 If no vehicle type is specified, either Type I (Inorganic) or Type II (Organic) is acceptable (see Section 2.3).

2.1.3 If no zinc level is specified, zinc levels 1, 2, and 3 are acceptable (see Section 2.5).

2.2 COMPOSITION: The coating described in this specification consists of zinc dust, functional additives, and an organic or inorganic binder with appropriate solvents (see Note 12.2).

2.3 VEHICLE TYPES

2.3.1 Type I-A, inorganic post-curing vehicles—water-soluble, include materials such as alkali metal silicates, phosphates, and modifications thereof that must be subsequently cured by application of heat or a solution of a curing compound (or curing solution).

2.3.2 Type I-B, inorganic self-curing vehicles—water-reducible, include water-soluble alkali metal silicates, quaternary ammonium silicates, phosphates, and modifications thereof. These coatings cure by a reaction among the zinc, silicate, steel substrate, and naturally occurring carbon dioxide during and 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 from the atmosphere to complete hydrolysis, forming the titanate- or polysilicate-zinc reaction product.

2.3.4 Type II, organic vehicles covered by this specification may be chemically cured or may dry by solvent evaporation (see Note 12.3). Under certain conditions heat may be used to facilitate or accelerate drying and curing.

2.4 COMPONENTS: These zinc dust primers may consist of one, two, or three components.

2.5 ZINC DUST LEVEL CLASSIFICATION: The coating shall be classified according to the level of zinc dust by weight present in the dried film as follows:

Level 1 — equal to or greater than 85%
Level 2 — equal to or greater than 77% and less than 85%
Level 3 — equal to or greater than 65% and less than 77%

3. Referenced 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. Standards marked with an asterisk (*) are referenced only in the Notes, which are not requirements of this specification.

3.2 If there is a conflict between the requirements of any of the cited referenced standards and this specification, the requirements of this specification shall prevail.

3.3 SSPC STANDARDS AND JOINT STANDARDS:

	Guide 13	Guide for the Identification and Use of Industrial Coating Material in Computerized Product Databases
	PA 2	Measurement of Dry Coating Thickness with Magnetic Gages
*	**Paint 29**	Zinc Dust Sacrificial Primer, Performance-Based
	Paint 30	Weld-Through Inorganic Zinc Primer
	SP 1	Solvent Cleaning
	SP 5/NACE No. 1	White Metal Blast Cleaning
	PS Guide 12.00	Guide to Zinc-Rich Coating Systems
*	**PS 12.01**	One-Coat Zinc-Rich Painting System

3.4 ASTM INTERNATIONAL STANDARDS:[1]

	A 572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
	B 117	Test Method of Salt Spray (Fog) Testing
	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 714	Standard Test Method for Evaluating Degree of Blistering of Paints
*	**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 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 3278	Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus
	D 3359	Test Methods for Measuring Adhesion by Tape Test
	D 4380	Practice for Sampling Liquid Paints and Related Pigmented Coatings
	D 4417	Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
*	**D 5894**	Practice for Cyclic Corrosion/UV Exposure of Painted Metal (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)

3.5 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:[2]

Z129.1	Hazardous Industrial Chemicals—Precautionary Labeling

3.6 FEDERAL SPECIFICATIONS AND STANDARDS:[3]

FED-STD-141 Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

*	**Method 3011**	Condition in Container
	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.

[1] ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.
[2] American National Standards Institute, 1819 L Street, NW, Suite 600, Washington, DC 20036. Standards downloadable from www.ansi.org.
[3] FED STD 141 Available from USA Information Systems, Inc. 1092 Laskin Road, Suite 208, Virginia Beach, Va. 23451. This standard is available on-line from www.usainfo.com.

4.2 PIGMENTATION

4.2.1 The major pigment component in these coatings is zinc dust of the type described in ASTM D 520 (see Note 12.4). The amount of zinc dust by weight present in the dried film shall be as specified in accordance with Section 2.5.

4.2.2 Other pigment components may include extenders, curing aids, tinting colors, and suspension and pot-life control agents.

5. Standard Testing Conditions

5.1 TEST PANELS: The hot rolled steel test panels shall conform to ASTM A 572. Panel size shall be 100 mm x 150 x 3.2 mm (4 x 6 x 1/8 inches) or greater. 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 and have a blast profile of 44 to 57 micrometers (1.75 to 2.25 mils). Measure the blast profile in accordance with ASTM D 4417, Method C.

5.2 APPLICATION: The coating shall be spray-applied as a single coat in accordance with the coating manufacturer's written recommendations.

5.3 DRY FILM THICKNESS: The dry film thickness (DFT) of the test panels shall meet the manufacturer's written recommended minimum and shall not exceed the manufacturer's stated minimum by more than 25 micrometers (1 mil). If there is no recommended film thickness, then the thickness shall be 60 to 90 micrometers (2.5 to 3.5 mils). The DFT shall be measured in accordance with the Annex.

5.4 CURE: The coating shall be dried and cured in accordance with manufacturer's written recommendations. Before any testing, all coated panels shall be aged for a minimum of 30 days in an environment with a minimum relative humidity of 55%.

5.5 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.

5.6 BACKS AND EDGES: Coat and seal all edges and the back side of each panel with a coating or tape that will provide the necessary protection to these surfaces.

6. Requirements of Liquid Coating

6.1 MIXING: The liquid portion of a multi-component coating shall be mixed and dispersed to produce a product that is uniform, stable, free from grit, and in conformance with the requirements of this specification.

6.1.1 The pigment portion of a multi-component coating (if supplied as a dust) shall be dry and loosely packed prior to mixing.

6.1.2 The ready-mixed coating shall be capable of being dispersed under mechanical agitation to a smooth, uniform consistency and shall not show any objectionable properties in the mix.

6.1.3 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 the total coating, regardless of type, in accordance with ASTM D 185. If required for new technology coatings, an alternate screen size may be agreed to among the contracting parties.

6.2 POT LIFE: The pot life of a multi-component zinc-rich coating, when mixed and ready for application in accordance with the manufacturer's written instructions, shall not be exceeded. Pot life with adjustments for temperature and humidity shall be provided by the coating manufacturer. Properly mixed and applied material used up to the end of the pot life shall pass the adhesion test described in Section 7.2.

6.3 STORAGE LIFE: Neither the vehicle of the multi-component coating nor the ready-mixed coating shall show thickening that is detrimental to performance or application properties. The components or coating 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 sealed, unopened container at a temperature of 10 to 32°C (50 to 90°F).

6.4 WORKING PROPERTIES: The mixed coating shall spray easily and show no signs of, streaking, running, sagging, or other objectionable features when applied within the coating manufacturer's recommended film thickness range and tested in accordance with FED-STD-141, Methods 4331 and 4541.

6.5 FLASH POINT: The minimum flash point, as determined by ASTM D 3278, should be "none" for inorganic water-based zinc dust coatings, and a minimum of 4.4°C (40°F) for solvent- based inorganic zinc primers (Type I) and for organic zinc primers (Type II).

7. Laboratory Physical Tests of Applied Films

7.1 MUDCRACKING: The coating, when applied and aged in accordance with Sections 5.1, 5.2, and 5.4 to a 125 micrometer (5 mil) minimum dry film thickness, shall show no signs of mudcracking visible to the eye unaided by magnification.

7.2 ADHESION: The coating, when applied, dried, and cured in accordance with Section 5, shall be tested per ASTM D 3359, Method B. There shall be no separation of the coating or delamination of an entire square. Loss of adhesion around the perimeter due to cutting of each square is acceptable. The adhesion rating shall be no less than grade 4B.

8. Accelerated Laboratory Weathering Test

8.1 SALT FOG EXPOSURE TEST: Triplicate panels prepared in accordance with Section 5 shall be exposed in a salt fog cabinet in accordance with ASTM B 117. Inorganic coatings (Type I) shall be exposed for 3000 hours and organic coatings (Type II) shall be exposed for 1000 hours (aee Notes 12.5 and 12.6).

8.1.1 Rust Evaluation: After the specified exposure time, each replicate panel shall have no rusting of the coated portion. Slight rusting in the scribe mark is permissible and resulting staining should be ignored. Strips 6 mm (1/4 in) wide along the edges of the panel may be ignored.

8.1.2 Blister Evaluation: After the specified exposure time, there shall be no blistering for Type I coatings; medium blistering is permitted for Type II coatings per measurement guidelines of ASTM D 714.

8.1.3 Scribe Evaluation: After the specified exposure time, there shall be no undercutting from the scribe.

9. Labeling

9.1 Labeling shall conform to ANSI Z129.1.

9.2 Technical data shall be provided for at least all data elements categorized as "essential" in SSPC-Guide 13.

10. Inspection

10.1 All materials 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 that are found to be defective under this specification (see Notes 12.7 and 12.8). 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.

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 4380.

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 ensuring compliance with all governmental regulations.

12. Notes

Notes are not requirements of this specification.

12.1 USES: This primer covers a range of vehicle types (inorganic/organic, water-borne/solvent-borne, one-pack/two-pack/three-pack, chemical curing/thermoplastic). A detailed description of environmental zone conditions is contained in Chapter 1 of the *SSPC Painting Manual, Vol. 2–Systems and Specifications, Eighth Edition*. Consult SSPC-PS Guide 12.00 and coating manufacturers for specific exposure limitations. PS 12.00 does not address zinc dust loading. Caution should be used when zinc-rich coatings contact austenitic stainless steel. In case of fire, molten zinc metal may cause embrittlement of austenitic stainless steel.

12.2 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 less than 500 g/L (4.2 lb/gal).

12.3 TYPE II, ORGANIC VEHICLE TYPES: Typical of this group of vehicles are phenoxies, catalyzed epoxies, epoxy esters, moisture-curing polyurethanes, styrenes, silicones, and vinyls. This listing is not all-inclusive.

12.4 LEAD LEVEL IN ZINC DUST: ASTM D 520 specifies three types of zinc dusts for use as pigments in coatings. Type I is a general grade in which no maximum level of lead is specified. Type II is a high-purity grade with a maximum lead level of 0.01% by weight. Type III is the highest purity grade, with a maximum lead level of 0.002% by weight. Any grade of zinc dust can be used in the zinc coatings covered by this specification. However, it is important to note that if Type I zinc is used, it is possible to exceed the permissible exposure limit (PEL) for lead when the products are removed by abrasive blasting. For additional information relating the lead content of the coating to worker exposure to lead during blasting see Gary L. Tinklenberg and Denise M. Doezema, "Health Concerns for Workers Using Zinc-Rich Coatings," *Journal of Protective Coatings and Linings*, Vol. 15, No. 5 [May 1998], pp 36-46. In addition to lead, cadmium and other toxic metals may pose a health hazard. Placing overly restrictive requirements on some materials may result in the inability of manufacturers to produce products meeting this specification.

12.5 Coatings that fail the ASTM B 117 test may perform well under actual service conditions. For most coatings, the use of ASTM D 5894 instead of ASTM B 117 has proven to be a more reliable predictor of performance. However, it appears that untopcoated zinc-rich primers may still be reasonably evaluated using ASTM B 117.

12.6 ADDITIONAL QUALIFICATION TESTS: Because of the diversity of potential service environments, the user may require the zinc-rich coating be further exposed and qualified by at least one additional test relating to the intended exposure. 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.

12.6.1 Immersion Tests: If, for example, 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:

- Synthetic Sea Water Immersion (4,000 hours) ASTM D 1308
- Oil Immersion (4,000 hours) ASTM D 1308
- A cyclic combination of both

Comparative testing of all candidate zinc-rich coatings will be more meaningful than individual testing of each coating.

12.6.2 Sources for Other Tests: Standard tests that 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 the 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.

12.7 The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

12.8 QUALITY ASSURANCE TESTS: If the user chooses, tests may be used to determine the acceptability of a lot or batch of a qualified coating. 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.

12.8.1 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 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.

12.8.2 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), color (ASTM D 1535), condition in container (FED-STD-141, Method 3011), and odor (ASTM D 1296).

12.9 For a performance specification of a zinc coating, refer to SSPC-Paint 29.

ANNEX – Method for Measuring Dry Film Thickness on Coated Steel Test Panels

1. Panel Size: The test panel shall have a minimum area of 116 cm^2 (18 $inch^2$) and a maximum area of 930 cm^2 (144 $inch^2$); e.g., minimum 7.5 x 15 cm (3 x 6 inch) and maximum 30 x 30 cm (12 x 12 inches).

2. Procedure: Use a Type 2 constant pressure probe gauge as described in SSPC-PA 2. Take two gauge readings from the top third, the middle third, and the bottom third of the test panel. Readings should be taken at least 25 mm (1 inch) from any edge and from any other gauge reading. Discard any unusually high or low gauge reading that cannot be repeated consistently. Take the average of the six acceptable gauge readings.

3. Minimum Thickness: The average of the acceptable gauge readings shall be no less than the specified minimum thickness. No single gauge reading shall be less than 80% of the specified minimum.

4. Maximum Thickness: The average of the acceptable gauge readings shall be no more than the specified maximum thickness. No single gauge reading shall be more than 120% of the specified maximum. If no maximum thickness is specified, the maximum shall be 2 mils above the minimum or 135% of the minimum DFT, whichever is greater.