SECTION P1

SHOP APPLIED COATINGS AND LININGS

1. GENERAL: This specification describes the general requirements for surface preparation, application, and inspection of shop applied external coatings and shop applied internal linings. This section does not cover field applied coatings and field applied internal linings.

1.1 The required Seller document submittals for the scope of work are summarized in this specification, the Seller's Deliverable Schedule (SDS), and the specific equipment technical specification sections. All required document submittals shall be provided by Seller and approved by Buyer prior to the start of work unless specified otherwise.

1.2 All conflicts, exceptions, deviations, and proposed substitutions to the requirements specified herein require Buyer approval prior to Seller proceeding with changes.

2. REFERENCES: The following Codes and Standards are referenced herein and form part of the technical requirements. Current editions of the Codes and Standards, including all mandatory addenda in effect at the time of the order, shall apply unless otherwise indicated.

Name	Description
ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A193/A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Services and Other Special Purpose Applications
ASTM A194/A194M	Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A384	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A385	Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A780/A780	Standard Specification for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM D3359	Standard Test Methods for Rating Adhesion by Tape Test
ASTM D4285	Standard Test Methods for Indicating Oil or Water in Compressed Air

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Name	Description
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D4752	Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub
ASTM D5162	Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
ASTM E337	Standard Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures)
ASTM F0022	Standard Test Method for Hydrophobic Surface Films by the Water-Break Test
ASTM F3125	Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength
ASTM F3393	Standard Specification for Zinc-Flake Coating Systems for Fasteners
ISO 2178	Non-magnetic coatings on magnetic substrates - Measurement of coating thickness - Magnetic method
ISO 2360	Non-conductive coatings on non-magnetic electrically conductive base metals - Measurement of coating thickness - Amplitude-sensitive eddy current method
ISO 2409	Paints and varnishes - Cross-cut test
ISO 4624	Paints and varnishes - Pull-off test for adhesion
ISO 4677-2	Atmospheres for conditioning and testing - Determination of relative humidity - Part 2: Whirling psychrometer method
ISO 8501-1	Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness - Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
ISO 8502-2	Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 2: Laboratory determination of chloride on cleaned surfaces
ISO 8502-5	Preparation of Steel Substrates Before Application of Paints and Related Products - Tests for the Assessment of Surface Cleanliness - Part 5: Measurement of Chloride on Steel Surfaces Prepared for Painting (Ion Detection Tube Method)

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Name	Description
ISO 8502-9	Preparation of steel substrates before application of paints and related products - Tests for the assessment of surface cleanliness - Part 9: Field method for the conductometric determination of water-soluble salts
ISO 8503-5	Preparation of steel substrates before application of paints and related products - Surface roughness characteristics of blast-cleaned steel substrates - Part 5: Replica tape method for the determination of the surface profile
ISO 8504-2	Preparation of steel substrates before application of paints and related products - Surface preparation methods - Part 2: Abrasive blast-cleaning
ISO 8504-3	Preparation of steel substrates before application of paints and related products - Surface preparation methods - Part 3: Hand- and power-tool cleaning
ISO 11126-1	Preparation of steel substrates before application of paints and related products - Specifications for non-metallic blast-cleaning abrasives - 10 Parts
ISO 12944-1	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 1: General introduction
ISO 12944-2	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 2: Classification of Environments
ISO 12944-4	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 4: Types of surface and surface preparation
ISO 12944-7	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 7: Execution and supervision of paint work
SSPC-AB 1	Mineral and Slag Abrasives
SSPC-AB 2	Cleanliness of Recycled Ferrous Metallic Abrasives
SSPC-AB 3	Ferrous Metallic Abrasive
SSPC-PA 1	Shop, Field, and Maintenance Painting of Metals
SSPC-PA 2	Measurement of Dry Coating Thickness with Magnetic Gauges
SSPC-PA Guide 10	Guide to Safety and Health Requirements for Industrial Painting Projects
SSPC-QP 3	Certification Standard for Shop Application of Complex Protective Coating Systems
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 8	Pickling

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Name	Description
SSPC-SP 10 / NACE No. 2	Near-White Metal Blast Cleaning
SSPC-SP 11	Power Tool Cleaning to Bare Metal
SSPC-SP 16	Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
SSPC-VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
NACE SP0178	Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service
NACE SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE SP0490	Holiday Detection of Fusion-Bonded Epoxy External Pipeline Coatings of 250 to 760 µm (10 to 30 mil)

3. DEFINITIONS:

Acronym or Term	Meaning
Atmospheric Surfaces	Surfaces of the equipment which are not permanently encased or covered and are visible and accessible for painting.
Coating	A specified protective surface treatment or barrier applied directly to the exterior surface of pipe, equipment, substrates, and structures to protect against external environmental factors while also meeting aesthetic requirements
Defect	A surface or film imperfection (flaw), deficiency, or incompleteness that deviates from a specification or industry-accepted condition
Exposed Surface	Surfaces of the equipment which are exposed to atmospheric conditions and are visible and accessible for painting.
Immersion Service	Implies exposure to continuous or intermittent wetting or submerged conditions. Surfaces include, but are not limited to, inside surfaces of tanks and pipes, buried and underground surfaces in contact with soil or fill, surfaces in sumps exposed to regular wetting, surfaces below the high water line or in the splash zone, inside stacks where condensation may occur and any other condensing surfaces. Wetting by rain is not considered immersion service. Coating under insulation is considered an immersion service. Surfaces intended for immersion service are subject to additional and more stringent requirements.
Lining	A specified protective surface treatment or barrier applied directly to the interior surface of pipe, equipment, substrates, and containment structures to protect against internal process hazards and aggressive substances
Coating Manufacturer	A company that produces and supplies coatings
Buyer Approved Seller's Standard Coating	A coating system that is selected and offered by the Seller that is suitable and meets or exceeds project requirements for service, environment, and durability requirements.

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Acronym or Term	Meaning
Shop	A controlled environment where temperature and humidity are regulated and maintained

4. QUALITY ASSURANCE

4.1 The Buyer reserves the right to inspect coating work at any time, and as such, access must be provided to locations of coating application. The presence of the Buyer's authorized inspector does not relieve the Seller of any inspection obligations.

4.2 The following additional quality assurance requirements shall be provided by the Seller as indicated in the Seller's Deliverable Schedule (SDS) and specific equipment technical specification sections.

4.2.1 A copy of a typical Quality Assurance/Quality Control inspection report.

4.2.2 Coating inspection certification documents (e.g., NACE, AMPP, formally trained) for the person responsible for performing coating inspections at the facility. This person will be responsible for submitting inspection reports to the Buyer.

4.2.3 A written statement from the Seller stating the coating supervisor and each applicator performing the work have been trained per the approved Quality Manual and are approved to apply the selected coating system.

4.2.4 A written endorsement from the coating manufacturer or approved alternatives such as coating manufacturer's brochures, product data sheets, or other literature which states the corrosivity category and durability of the coating system meets the requirements of this specification.

4.2.5 Surface preparation and coating system specifications including paint manufacturers name & catalog numbers. Cleaning, painting, storage, packaging, and shipping procedures. Seller shall attach the "Safety Data Sheets (SDS) with all painting/coating procedures.

4.3 All coating material containers shall be examined upon delivery. Any evidence of leaks, broken seals, freezing or other damage which may have resulted in any loss of the constituents by volatilization or otherwise shall be cause for rejection. Coating material containers shall be labeled to show the name of the manufacturer, the product trade name or designation, color and the expiration date. Containers shall have their labels intact and completely legible.

5. SAFETY

5.1 Protective coating applications shall comply with all applicable federal, state, and local codes and regulations on surface preparation, coating application, storage, handling,

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safety, and environmental requirements, including the recommendations of SSPC-PA Guide 10.

5.2 The Seller shall ensure that the Volatile Organic Compound (VOC) content of coatings do not exceed maximum levels specified in the current jobsite and shop jurisdictional regulations.

6. SCOPE

6.1 Surface preparation, application, and materials shall be applied in the shop in accordance with the Buyer's specified Table 1 – Extent of Coating and Finish Systems and Coating Systems at the end of this Section. Coatings shall have a minimum design life of 30 years without recoating. All steel material furnished under this Specification, except machined surfaces or as otherwise specified herein, shall be cleaned, primed and top coated and/or galvanized as required herein. A standard coating system is incorporated herein, which includes surface preparation, prime, intermediate (if required) and top coating material, required application procedure, and corrective procedure. Any conflict between this specification and the requirements or instructions of the Buyer, or the coating manufacturers, shall be brought to Buyer's attention in writing.

6.1.1 The Table 1 – Extent of Coating and Finish Systems summarizes the proper paint code(s) for each coating application. Each application's paint code(s) shall be correlated to the Coating Systems for specific information including surface preparation, coating layers, and approved products.

6.2 Coating materials used in the same system shall be supplied by the same manufacturer, unless otherwise approved by the Buyer.

6.3 The specific applications and requirements identified in the Buyer's Table 1 – Extent of Coating and Finish Systems and Coating Systems at the end of this Specification shall take precedent. Otherwise, the following Buyer Approved Seller's Standard Coating (BASSC) requirements apply where this specification does not specify a Buyer's Coating System or direct the Seller to use a Buyer Approved Seller's Standard Coating System:

6.3.1 Seller shall provide Buyer with a recommended coating system for all supplied equipment (e.g., pumps, valves, pipe, pipe supports, etc.) for the environment and intended service of that equipment. The coating system shall include identification of surface preparation, shop prime coating, shop finish coating, shop touch-up coating and coating materials required for the Work. Prior to coating application, the Seller shall submit the Seller's selected coating system(s) to the Buyer for approval. The Buyer reserves the right to reject any coating system(s) that do not meet the requirements of this General Requirements Specification. The Seller shall be responsible for the cost associated with replacing or repairing coatings that are rejected by the Buyer.

6.3.2 Use the Buyer Approved Seller's Standard Coating systems for electric motors, instrumentation, control panels, and other equipment components if it is not explicitly listed

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in the Table 1 – Extent of Coating and Finish Systems and Coating Systems at the end of this Section. Coatings applied to individual components shall be compatible with coatings on other components for assembled equipment and shall meet or exceed the corrosivity category and durability listed below.

6.3.3 The Buyer Approved Seller's Standard Coating System, and that of all sub-vendors, shall be suitable for the intended service and meet the corrosivity category and durability range requirements defined below based on ISO 12944.

a) Coating systems for outdoor service shall meet the criteria for: C3-Medium

b) Coating systems for heated, indoor industrial service shall meet the criteria for: C2-Medium

6.4 Shop welded contact surfaces, such as the faying surfaces between connection angles and beam webs shall be coated with an acceptable product before assembly or completely seal welded prior to coating to prevent rust formation. Inaccessible surfaces, the perimeters of which are continuously seal welded, need not be primed. An acceptable product for shop welded contact surfaces is Carbo-Weld 11 as manufactured by the Carboline Company, St. Louis, Missouri or equal.

6.5 All surfaces that are inaccessible after fabrication shall be completely painted in the manufacturer's factory prior to fabrication.

7. EXECUTION

7.1 Unless specified otherwise, all equipment shall be delivered with finish painting applied by Seller that is fully cured. Sufficient material quantity and craftsmanship shall be employed so that the entire surface is visually covered without skips, shadow-through or thin spots and relatively free of craters. Seller's applied coating shall be touched up by Buyer, as necessary, at field welds and on surfaces damaged during installation.

7.1.1 All shop applied external coating and/or internal lining systems shall be rated for the intended service's specified continuous maximum operating temperatures.

7.2 Coat all exposed ferrous surfaces subject to corrosion.

7.3 The following surfaces shall be evaluated on an individual basis:

7.3.1 Stainless steel pressure vessels, heat transfer equipment, small tanks, pipe and drums constructed of stainless steel including nozzles and attachments. Gasket sealing surfaces shall not be coated.

7.3.2 Grating, stair treads, galvanized steel requiring finish color coating and field replacement of galvanized coatings, and surfaces to be high-strength bolted with slip-critical connections (coating selection based on the slip coefficient required). The condition of contact

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surfaces of slip critical connections shall conform to the requirements of the RCSC Specification for the type of coating used.

7.4 Surfaces of the following materials or equipment shall not be coated unless specified otherwise:

7.4.1 Nonferrous metals, including non-ferrous metal castings, piping or other parts, in atmospheric conditions, galvanized surfaces, insulation jacketing, stainless steel, copper, smooth aluminum sheet, high-chrome alloy steel components, nameplates, and cast iron products such as manhole covers and grating. Perforated and cast aluminum shall be coated. Junction boxes, etc., shall be coated.

7.4.2 Nonmetallic materials such as treated wood products, tile, brick, ceramics, and thermoplastics including plastic and plastic-coated materials, fiberglass reinforced plastic (FRP), and polyvinyl chloride (PVC).

7.4.3 Do not apply coatings when environmental, substrate, material conditions or any other requirements do not conform to the coating manufacturer's written instructions.

7.5 Unless specified otherwise, the following surfaces shall be protected from surface preparation and painting activity on non-coated areas in addition to not being coated:

7.5.1 Any finished surface, component, or accessory that can be damaged by coating materials.

7.5.2 Labels such as Underwriters Laboratories (UL), Factory Mutual (FM), door tag, performance rating, inspection point identification markers, and any equipment nameplate & identification tags.

7.5.3 Installed hardware, sensing devices, glass surfaces of gage glasses & site glasses, motor & fan shafts, bearing surfaces, other moving parts of operating units, electrical contact points, and lighting.

7.5.4 Valve stems, internal surfaces of valves, resilient seal materials, gasket sealing surfaces, flange faces, pump bearing surfaces, plumbing fixtures and fittings, internal piping and connection surfaces, gasket contact surfaces, threaded joints, and other machined surfaces prior to mating.

a) Machined surfaces and weld end preparations shall be covered with rust preventative, plastic end caps and removable tape. Stainless steel substrates require removable tape that does not contain chlorides or halogens.

7.6 Coating Holdbacks

7.6.1 Holdbacks shall be straight-edged for the total thickness of every coating. Do not coat surfaces within four (4) inches (100 mm) of un-blasted surfaces or three (3) inches

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(75 mm) from the edges to be field welded. Shop welds that have been previously leak tested do not require a holdback.

7.6.2 A rust preventative weldable primer shall be applied to all non-stainless steel metallic bare piping exterior holdback areas prior to shipment using Cortec® VpCI-386 or Buyer approved equal. A rust preventative is not required for stainless steel. Rust preventatives must be removed prior to a leak test.

7.7 Protective Measures

7.7.1 Equipment components not intended to be painted shall be adequately protected during painting operation by removable tape or other means. Appropriate precautions shall be taken to prevent coatings being applied in one area from dripping or drifting onto previously coated surfaces or damaging previously coated surfaces. Suitable protective coverings shall be used when applying materials. Paint spots and fogging from sprays shall be removed from affected surfaces.

7.7.2 All austenitic stainless steel and nonferrous metals shall be protected from fabrication operations, blasting, overspray, and coatings intended for carbon and low-alloy steel, especially coatings containing zinc.

7.7.3 Coatings and solvents for use on stainless steel and nonferrous metals shall be free of substances such as chlorides, sulfates, halogens, or metallic pigments that can harmfully affect stainless steel or nonferrous metals.

7.7.4 Color-coding and fabrication markings applied directly onto stainless steel and nonferrous metals shall be applied with low-chloride markers.

7.7.5 For items having dual materials of construction, coatings containing zinc shall not overlap onto stainless steel or nonferrous metals, including the stainless steel (SS) to carbon steel (CS) weld. Examples of such applications include:

7.7.5.1 CS saddles and skirts on SS equipment, SS piping within CS skirts, SS nozzles, flanges, and piping on clad equipment, miscellaneous CS clips and brackets on SS equipment, SS components in CS piping systems, CS trunnions on SS piping and equipment, CS flange rings on SS lap joint flanges, and CS lap joint flanges coated before assembly and shipment.

8. SURFACE PREPARATION

8.1 Preparation of metal surfaces for coating systems shall follow the specifications and standard practices of the Society for Protective Coatings (SSPC), National Association for Corrosion Engineers (NACE), and the specific instructions of the coatings manufacturer. The preferred method of surface preparation is media abrasive blasting.

8.2 Preparation for Blasting

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8.2.1 All welds shall be relatively smooth, without sharp edges, and free of weld slag and weld spatter before blasting. Buyer shall be notified of such defects for corrective action before proceeding with work.

8.2.2 Unless approved in writing by Buyer, neither welding nor grinding, including cosmetic grinding, shall be permitted on the pressure-retaining components and welds of pressure vessels and piping after hydrostatic testing.

8.2.3 Before blasting, all visible deposits of oil and grease shall be removed using the methods defined in SSPC-SP 1.

8.2.4 Prior to blasting, bare metallic substrate with rust levels as defined by ISO 8501 exceeding Grade B for piping and Grade C for structural shall be rejected.

8.2.5 Soluble salt contamination testing shall be performed in accordance with ISO 8502-2 or ISO 8502-9 for immersion service applications. For atmospheric coatings, soluble salt contamination shall be per manufacturer's recommendation.

8.2.6 Fabrication that involves cutting of steel that leads to hardening of steel needs to be addressed to have the ability to conform to anchor profiles prior to coating application. A 2 mil radius shall be included on fabricated edges.

8.3 Abrasive Blasting

8.3.1 Abrasive blast cleaning shall be performed with a clean, sharp grade of abrasive. The minimum surface preparation for abrasive blasting shall meet the profile specified within the Coating Systems at the end of this Section. Where abrasive blast cleaning is required, abrasives shall be used that develop a substrate profile per the manufacturer's recommendation, but no less than 1.0 mil.

8.3.2 Abrasives for use on stainless steel shall be in accordance with SSPC-AB 1 or ISO 11126, natural abrasives (except silica sand) as well as coal furnace slag and fused aluminum oxide and shall be free of iron metals.

8.3.3 Grain size shall be suitable for producing the specified anchor profile.

8.3.4 All abrasives shall be free of dust, dirt, and other foreign matter and shall be kept dry at all times.

8.3.5 Blast media shall comply with SSPC AB1 Type 1 Class A, Type 2, SSPC AB2, or SSPC AMPP AB3. Blast media shall have a crystalline silica content of less than 1%. Refer to NIOSH Publication No. 92-102.

8.3.6 If automatic blasting equipment is used, the abrasive mix shall be maintained in accordance with SSPC AB2 so that a consistently sharp profile is produced and remains contaminant free.

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8.3.7 Abrasive blast cleaning of carbon steel or ferrous material shall not be performed if the ambient or substrate temperature is less than 5°F (3°C) above the dew point temperature.

8.3.7.1 Recirculated shot and grit used for abrasive cleaning shall be tested for the presence of oil by immersing in water and checking for oil flotation. Tests shall be made at the start of blasting, at 4-hour intervals thereafter or every time recirculated shot and grit is manually reloaded, and at the end of blasting. Requirements set forth in SSPC AB-2 shall be met for recycled (recirculated) abrasives.

8.3.7.2 If oil contamination in the abrasive is evident, then contaminated abrasive shall be replaced with clean abrasive and retested before proceeding. All steel blasted since the last satisfactory test shall be cleaned with solvent and re-blasted.

8.3.8 Prevent fallout from cleaning operations from being deposited on adjacent surfaces which are ready for coating and freshly coated surfaces. Where deleterious material may be deposited as a result of normal construction activities, a prepared surface shall either be protected or coated immediately. Areas where blast products have become embedded in the coating film shall be repaired by removing these particles and touching up the area.

8.4 Post-Blasting:

8.4.1 Blast-cleaned surfaces that show evidence of rust bloom shall be recleaned to the specified degree of cleanliness before coating.

8.4.2 All visible burrs, laminations, slivers, and scabs shall be removed or repaired after blasting.

8.4.3 After blasting and immediately before spraying, dust and loose residues shall be removed by brushing, blowing off with clean dry air, or vacuum cleaning.

8.4.4 Inhibitive washes intended to prevent rusting after blasting shall only be used with prior approval from Buyer.

8.4.5 Alternative forms of surface preparation shall not be used without written approval from the Buyer.

8.5 Degree of Cleanliness and Anchor Profile Post Abrasive Blasting

8.5.1 Surface preparation anchor profile shall be verified using either coarse or extra-coarse replica tape (as required by profile depth) and a calibrated micrometer in accordance with ASTM D4417, Method C. Anchor profile may also be verified in accordance with ISO 8503-5, when approved by Buyer.

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8.5.2 All blast-cleaned surfaces shall be inspected for proper cleaning before painting. SSPC-VIS 1 shall be used as a visual standard for confirming the degree of surface cleanliness. Initial rust grade must be documented when visual guide is used as inspection.

8.6 Hand or Power Tool Cleaning

8.6.1 Hand and power tool cleaning must follow coatings manufacturer's guidelines where specified. Otherwise, hand tool or power tool cleaning shall be in accordance with SSPC-SP 2, SSPC-SP 3, or SSPC-SP 11 and be able to produce the required anchor profile. Cleaning of surfaces, which are not to be painted or coated, shall be done according to the Seller's recommended practice.

8.6.2 If hand or power tool cleaning is required on stainless steel and nonferrous metals, only stainless steel wire brushes that have not been previously used on carbon steel surfaces shall be used.

9. APPLICATION

9.1 General

9.1.1 Application shall be in accordance with SSPC-PA 1, the coating manufacturer's published application instructions, Safety Data Sheet, and the requirements specified herein. Application shall occur immediately after surface preparation and cleaning unless a mitigation plan is approved by the Buyer. Application equipment shall be kept clean and free of contaminants or residues which could detract from the appearance or integrity of the deposited film.

9.1.2 Solvent cleaning to be performed in accordance with SSPC-SP 1 before and after each coat, and before and after surface preparation.

9.1.3 All shop coated surfaces intended to be field finished shall be primed with the Buyer's specified Coating Systems primer and compatible with the field finish unless otherwise specified.

9.1.4 All painting of surfaces of pressure containing parts shall be deferred until the specified nondestructive examination or pressure testing of that part is completed.

9.1.5 For coated piping systems that are fabricated in accordance with ASME B31.1, and where hydrostatic or pneumatic testing is to be performed in the field, all welds shall pass a radiographic, ultrasonic, dye/liquid penetrant, or magnetic particle examination performed by Seller prior to applying any coatings. Acceptance criteria shall be in accordance with the requirements of ASME B31.1. As an alternative to the additional examination prior to coating, Seller may pressure test finished piping spools in accordance with ASME B31.1 prior to coating. All test reports shall be submitted to the Buyer. For coated piping systems subject to initial service testing in the field, piping and welds shall be coated by Seller.

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9.2 Temperature, Humidity, and Weather Conditions

9.2.1 Coatings shall be applied to dry, frost-free surfaces and within the ambient condition parameters established in SSPC PA1, except as otherwise required or permitted herein. Application at temperatures (surface or ambient) in excess of 100°F or per the manufacturer's recommendation shall not be permitted if the resultant film is found to be prone toward bubbling, cratering, or pin holing. Paint shall not be applied while any of the following ambient conditions are present or expected before the paint cures:

9.2.1.1 Temperature: Ambient, substrate, or coating material temperatures are above 100°F (49°C), below 50°F (10°C), or outside the range recommended by the coating manufacturer.

9.2.1.2 Humidity: Relative humidity shall not exceed 85% unless approved by the coating manufacturer.

9.2.1.3 Dew Point: The ambient or substrate temperature is less than 5°F (3°C) above the dew point or outside the range recommended by the coating manufacturer.

9.2.1.4 All surfaces to be coated shall be protected from the weather continuously throughout the cleaning, coating, and curing periods.

9.3 Products

9.3.1 Refer to the Buyer's Coating Systems at the end of this Section for approved coating products & materials.

9.3.2 Only those types and brands of thinner recommended by the coating manufacturer shall be used for thinning. The amount of thinning shall be limited to the amount necessary to facilitate application. Surfaces which have been prepared, as required, and are ready for painting shall be painted as soon as practical.

9.3.3 Shelf Life: Coating materials shall be furnished in the coating manufacturer's unopened containers, clearly marked, and kept covered, clean, and protected. Materials that have exceeded the coating manufacturer's recommended shelf life shall not be used.

9.3.4 All materials shall be handled and stored in accordance with the coating manufacturer's latest published instructions and SSPC-PA 1.

9.3.5 Seller shall indicate on submitted drawings the coating manufacturer and coating product numbers used.

9.3.6 Pot Life: Coating manufacturer's recommended pot life shall not be exceeded. Thinner shall not be used to extend pot life.

9.4 Mixing and Thinning

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9.4.1 Materials shall be mixed and thinned in accordance with the coating manufacturer's written instructions. Mixing shall conform to the requirements of SSPC PA1 except as otherwise required below. Paint, which has skinned, gelled, separated or otherwise deteriorated during storage to the extent that normal thinning will not restore the paint to its intended viscosity, uniformity, and consistency, shall not be used. All paint shall be strained after mixing.

9.4.2 All mixing shall be done in clean containers that are free from grease, paints, and other contaminants. Containers shall be kept covered to prevent contamination by dust, dirt, or rain.

9.4.3 Mixing of partial kits shall not be permitted.

9.4.4 Inorganic zinc primers and all pigmented coatings shall be strained before application in accordance with the coating manufacturer's written instructions.

9.4.5 Thinning shall not exceed the maximum allowable VOC level for the coating.

9.5 Protective Coatings

9.5.1 All coating products except zinc rich primers used shall be certified 100% lead free. Coatings shall not exceed 0.06% chromium in the dried film. Zinc rich primers shall be restricted to ASTM D520 Type II. All zinc rich coatings shall contain not less than 80% metallic zinc by weight of total solids in the dried film. The use of "reinforced inorganic zinc" is unacceptable. This painting system involves zinc-rich paint, gray in color, with material requirements meeting SSPC PS12, surface preparation meeting SSPC SP6 without appendix.

9.5.2 When primer is not a zinc, stripe coat (including primer, intermediate, and finish coat) all edges, edges of rolled steel, welds, bolts, flanges, hardware, and protrusions.

9.5.3 Primers shall be applied before flash rusting or other contamination occurs.

9.5.4 Previously coated surfaces shall be protected from contamination and overspray.

9.5.5 Primer shall have a uniform thickness over welds, edges, and corners and shall be free of mud cracking.

9.5.6 Primer shall not be applied to coating holdback areas defined in this Specification.

9.5.7 Inorganic zinc-rich primers shall be applied using an agitated pot. Low speed pot agitators shall be used to keep zinc in suspension when applying primers containing zinc

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dust. Zinc primers shall be properly cured and free from dry spray and mud cracking. Where present, these shall be removed, and the coating repaired.

9.5.8 Inorganic and organic zinc rich primers shall not be used in an immersion service including under insulation.

9.5.9 Before applying subsequent coat over zinc primer, curing must be verified using a MEK Rub Test per ASTM D4752.

9.5.10 The colors of the primer, intermediate, and finishing coats of a paint system shall be easily distinguishable from each other. Where more than one topcoat is applied, the underlying coat(s) shall be tinted a different shade than the required final coat color to facilitate proper coverage and to allow for clear differentiation between coats. Only the specific tinting agents recommended by the coating manufacturer shall be used. Specifically, with urethane coatings, only solvent base universal tints shall be used.

9.5.11 The minimum drying time before handling the coated material shall be in accordance with the manufacturer's recommendations. Subsequent finish coats, if required, shall be applied only after the previously applied coat has been allowed to dry for the necessary dry-to-recoat interval as specified by the manufacturer. Inorganic zinc coatings shall be allowed to cure overnight before the contact surfaces of individual parts are assembled together.

9.5.12 Minimum recoat and overcoat times between coats shall be in compliance with the coating manufacturer's instructions. If the maximum recoat time has been exceeded, refer to product data sheet prior to overcoating.

9.5.13 Inorganic zinc primers shall be thoroughly cleaned and cured before top coating. All overspray shall be removed and welds thoroughly cleaned with a stiff bristle brush or wire screen.

9.5.14 When top coating inorganic zinc primer, first apply a seal/mist coat at a sufficiently rapid rate to seal the surface without obtaining any significant film build, then proceed with application of the coating to the specified film thickness. A mist coat shall be used to avoid off-gassing if spray applying over inorganic zinc primers. The mist coat may be a thinned coat or applied by a quick pass of the spray gun. Product specification for cure time shall be followed for solvent evaporation before applying full coat.

9.5.15 Zinc primer shall not exceed 5 mils.

9.5.16 If using a non-zinc primer, stripe coats must be performed using a contrasting color.

9.5.17 Finish coat for outdoor service shall be UV stable and not chalk or fade when exposed to sunlight.

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9.5.18 For each coating system identified, all coats applied shall be by the same coating manufacturer.

9.5.19 Top coating shall not exceed the maximum dry film thickness requirements or recommendations from the Manufacturer.

9.6 Film Thickness

9.6.1 Wet film thickness (WFT) shall be checked during the application of each coat to assure the specified dry film thickness (DFT) will be met. WFT measurements are not suitable for materials such as inorganic zinc primers and flake filled epoxies.

9.6.2 For film thickness measurement, the requirements and recommended practices of SSPC-PA2 shall be followed. Testing shall be performed for all of the Work processed during any coating shift for one full day per coating work week for all steel. Film thickness should be recorded daily for all coatings applied and subsequent coats.

9.6.3 Readings should be taken on smooth regular surfaces, not at corners, pockets, edges, bolt heads, fillets, etc. Representative "sample areas" should be established on the surface prior to making film thickness reading.

9.6.4 DFT of each coat shall be within tolerances listed on coating manufacturer's product data sheet or technical bulletin. Measurements shall be taken after removal of dry spray and overspray.

9.6.5 The size of the sample area shall be as follows:

Surface	Sample Area
Large plate surfaces	Every 200-300 sq ft
Structural steel beams, columns, bracing, etc.	Every 15-20 linear ft on every 10th member

9.6.6 Three or more spot readings shall be taken in any sample area being inspected. This includes items with a total surface area less than one sample area.

9.7 Mechanical Piping & Equipment Flange Bolt Coatings

9.7.1 All selected bolting component materials and coatings shall be suitable for the intended service and meet the corrosivity category and durability range requirements defined in this Section.

9.7.2 Zinc-coated bolts, studs, cap screws, and nuts shall not be used in applications with a fluid maximum operating temperature greater than 390°F per ASTM A193 and ASTM A194 recommendations.

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9.7.3 Cadmium-coated bolts, studs, cap screws, and nuts shall not be used in applications with a fluid maximum operating temperature greater than 300°F per per ASTM A193 and ASTM A194 recommendations.

9.7.4 Bolts, studs, cap screws, and nuts used in galvanized pipe systems shall be galvanized or zinc electroplated.

9.7.5 PTFE-coated bolts, studs, cap screws, and nuts shall be used in applications with fluid maximum operating temperatures that exceed the limitations of zinc and cadmimum plating. Coastal or corrosive environments may also necessitate the use of PTFE-coated fasteners. PTFE-coatings shall adhere to the manufacturer's written instructions and limitations for various environments. Seller shall ensure PTFE-coated fastener components are undamaged prior to shipment. Damaged components shall be replaced by Seller.

9.8 Defects

9.8.1 Coatings shall be applied in accordance with the requirements of SSPC PAl, supplemented by requirements of the coating manufacturer and application requirements of this specification. As per SSPC-PA1, each coat of paint shall be free of defects (e.g., pinholes, voids, bubbles, skips, runs, sags, blisters, wrinkles, amine blushes, and mud cracking), and of uniform thickness and appearance. All coats shall have smooth, streamline surfaces relatively free of dryspray, overspray, orange peel, and other significant surface defects. Such imperfections, if visible at a distance of 5 ft. or more, shall be repaired.

9.8.2 Care shall be exercised to prevent overspray, spillage, or application of coatings to surfaces for which they are not intended. Dry spray and overspray shall be removed.

9.9 Touch-Up

9.9.1 Before application of any coat, all defects and damage to the previous coat(s) shall be repaired. Damage to finished work shall be thoroughly cleaned and recoated. Spot touch up priming shall be accomplished before rust has formed on the cleaned surface. The prepared spot or area shall be cleaned with a cleaning solvent and allowed to dry completely before applying topcoat materials. Touch up materials for spot priming shall be brushed applied.

9.9.2 Damaged areas shall be spot-blast cleaned, power tool cleaned, or hand tool cleaned as necessary to restore any exposed steel to an original degree of cleanliness and anchor profile. All loose, cracked, and damaged coating shall be removed and the adjacent sound coating feathered back to form a uniform and smooth surface. Feathering shall be done by hand or power sanding with a grit wheel or sandpaper. The prepared surface shall be free of loose, burnt, or blistered coating.

9.9.3 Furnish touch-up paint upon Buyer's request. The touch-up paint shall be as recommended by the coating manufacturer, and compatible with the shop applied coating. Volatile organic compound (VOC) content of touch-up paint shall not exceed the limits of the

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authority/agency having jurisdiction (AHJ) at the project site, or as well as at the location where touch-up paint is applied.

9.9.4 Unless specified otherwise, the coating used for repair shall be the same as the original and shall have the same DFT.

9.9.5 Surfaces which have been prepared and touched up as required and are ready for coating shall be coated as soon as practicable after the spot priming or touch up coating material has thoroughly dried, to minimize the chance of recontaminating the prepared surface.

10. PIPING & EQUIPMENT COLOR CLASSIFICATION

10.1 Finish colors are to be determined by Buyer and meet the color requirements specified in the Table 1 – Extent of Coating and Finish Systems at the end of this Section. The Seller shall submit the coating manufacturer's standard color charts, chips or samples for selection of final finish colors by Buyer. Actual finish color hue may differ based on coating batch number and or application conditions. The final colors and identification systems for the Equipment shall be generally in accordance with Good Industry Practices, and agreed with the Buyer. Final paint colors shall be determined during the drawing review stage of the work and shall be manufacturers' standard colors with the Buyer's approval. Chrome, silver and highly reflective colors are not acceptable.

10.2 Safety Color Code Coating: Items indicated below shall be coated with safety colors complying with ANSI/NEMA Z535.1 ISCC-NBS color designations and block numbers and as specified and approved by Buyer. Color coating for safety colors is in addition to galvanized coating. Colors should be non-fading and non-chalking.

10.2.1 Diagonal Bracing and Gusset Plates:

10.2.1.1 Diagonal bracing in open bays subject to passage of personnel and equipment: Apply safety yellow coating to a height of 8 feet from floor.

10.2.1.2 Diagonal bracing in open bays subject to passage of personnel and equipment: Bottom gusset plates shall be Safety Yellow.

10.2.1.3 Top gusset plates, balance of diagonal bracing, and diagonal bracing in plane of wall; same as specified for structural steel.

10.2.2 Guardrails/Handrails, Ladders and Safety Cages:

10.2.2.1 Guardrails/Handrails: Safety Yellow.

10.2.2.2 Ladders: Safety Yellow.

10.2.2.3 Safety Cages: Safety Yellow.

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10.2.2.4 Swing Gates: Safety Yellow.

10.2.3 Stair Nosings and Grating Edges of Galleries:

10.2.3.1 Steel Stair Nosings: Coat top 2 and bottom 2 nosings, 3 inches wide top and face, full width of stair – Safety Yellow.

10.2.3.2 Steel Grating Edges: Where there is only one-step directional between grating areas and no handrail occurs, coat the nosing of the higher grating and the face of the riser completely – Safety Yellow.

10.2.4 Trolley Beams: Safety Yellow. The design capacity of the trolley beam shall be stenciled on both sides of the web at the approximate midspan of each beam, using the notation "CAPACITY __ TONS" lettered in 3-inch-high block letters with black paint.

10.2.5 Piping: As specified by ANSI 13.1 and ANSI/NEMA Z535.1.

10.2.6 Fire Hose Cabinets, Extinguishers and Hose Outlet Areas:

10.2.6.1 Coat fire hose cabinets (excluding hose and hose connections) and branch piping to approximately 5 feet on both sides of the fire house cabinets.

10.2.6.2 Mounted on Walls: Apply a background panel of Safety Red color extending approximately 1 foot on both sides of the fire hose cabinets.

10.2.6.3 Mounted on Columns or Posts: Apply a band of Safety Red color completely around the column or post, extending approximately one foot above and one foot below the facility.

10.2.6.4 Fire hose cabinets in architecturally finished areas shall not be coated.

10.2.7 Dangerous parts of equipment or energized equipment as defined in ANSI 253.1 shall be identified and coated Safety Yellow.

10.2.8 First Aid Kits, Stretchers, Eye Wash Stations, and Flush Showers shall be coated in Safety Green to the extent indicated, include white lettering.

10.3 Piping Color Codes:

10.3.1 Surface preparation and painting system shall be in accordance with Table 1 – Extent of Coating and Finish Systems.

10.3.2 Aluminum lagging and insulation covering shall be unpainted.

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10.3.3 Piping color codes shall be in accordance with ANSI Z353.1. Piping shall be color coded with standard pipe labels per ANSI 13.1 Table 2 and colors per ANSI/NEMA Z535.1. Pipe labels to include pipe content and direction of flow.

10.4 The color of prefabricated enclosures and shelters shall be as selected by the Buyer and duly implemented by the Seller to ensure a common color scheme across the entire Facility.

11. INTERIOR LINING SYSTEMS

11.1 Lining systems protect the interior surface against corrosion and/or erosion by applying materials such as epoxy, urethane, cement-mortar, coal-tar enamel, rust preventatives, electroplating or other approved method.

11.2 All lining systems used for drinking water applications shall be tested and certified for compliance with the specifications of the NSF International/ American National Standards Institute, Standard 61 (NSF/ANSI 61), and applicable Federal and Local Regulations.

11.3 Rust Preventatives (RP) and Preservative Coatings

11.3.1 Surfaces that may corrode, and are not intended to be coated, shall be protected with a rust inhibitor or rust-preventive compound. Rust-preventive compound shall be compatible with the intended substrate and service as specified in the following table. Rust preventatives shall be water soluble or oil soluble to ensure easy removal during commissioning. Powder vapor phase corrosion inhibitors shall not be used without the Buyer's approval due to difficulty of removal.

11.3.1.1 Preservative coatings used on components shall be suitable for the conditions normally expected during shipping, storage and throughout the erection period. Seller shall monitor and reestablish as necessary any preservatives or coatings that have deteriorated and become ineffective in accordance with the requirements of the coating manufacturer.

11.3.1.2 Each type of preservative used shall be identified as to quality, life expectancy and type. Toxic and hazardous type preservatives shall not be used. Safety Data Sheets (SDSs) shall be provided for all preservatives shipped to or used on to the project site. The SDSs shall be submitted to the Buyer and shall cover step-by-step procedures, including federal, state and local governing controls for handling and removal of each type of preservative. The material represented on these SDSs requires approval by the Buyer prior to the bringing or shipping the material on the project site.

11.3.2 Provide rust preventatives for all internals where the material is susceptible to corrosion and such corrosion would need to be removed prior to placement in service. Rust preventatives for components in the steam cycle shall be free of silicone compounds (including silica and silicate) to minimize the risk of scaling, fouling and corrosion of the

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steam turbine or boiler. Milled surfaces shall be coated with a rust-preventative material. Coating shall be applied after the Seller's inspection and prior to being placed outdoors.

11.3.3 For any piping with an interior lining, including rust preventative, flange faces shall be furnished with a rust inhibitor. The inside of flange bolt holes shall be coated with either the permanent interior lining specified or the exterior coating specified. Rust preventative compound alone will not suffice.

11.3.4 Rust preventatives shall be provided for piping internals as follows:

11.3.4.1 Piping for air, CO2, and nitrogen do not require RP regardless of piping material.

11.3.4.2 Stainless steel, galvanized steel, HDPE, PVC, Cast Iron, Ductile Iron, and copper do not require RP regardless of service.

11.3.5 Seller shall provide a qualified rust preventative product as defined in Table 2 or Buyer approved equal substitute. Seller shall provide maintenance instructions and manufacturer's datasheets for the selected RP including shelf life expiration and reapplication times.

11.3.5.1 Insulated piping or equipment that operates continuously between the temperature range of 25°F (-4°C) to 350°F (175°C) shall not be coated with alkyd rust preventative primers such as "Red Oxide".

Table 2 – Qualified Rust Preventative Products

Manufacturer	Water Soluble RP Product	Silica Free Water Soluble RP Product	Oil Soluble RP Product	Vapor Corrosion Inhibitor
Cortec	VpCI-337	VpCI-309 SF	No Offering	No Offering
Daubert	No Offering	No Offering	NOX Rust VCI-10	No Offering
Zerust/Excor	No Offering	No Offering	No Offering	Zerust ICT

11.3.6 CLEANLINESS CONTROL: Interior Cleanliness control and rust preventatives shall be provided for piping internals as defined in Table 3.

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Table 3 – Cleanliness Control & Interior Rust Preventative Guideline for All Seller Supplied Piping

Cleanliness Code	Definition	Examples[4]	Piping Material	Fabrication	
				Cleaning (1, 2)	Rust Preventative (3)
CC-1	Cycle Systems	Steam or water systems that are part of the steam turbine cycle including main process steam, Boiler Feedwater, Auxiliary Steam, and Condensate	CS	SP6	SFWS
			Chrome	SP6	SFWS
CC-2	Cycle Systems	Other steam or water systems that are not connected to a steam turbine including Demineralized Water, Circulating Water, Service Water, Fire Protection, and Blowdown	CS	PFI	VCI
			Chrome	PFI	VCI
			SS	PFI	CP
CC-3	Utility Systems	Cooling water systems that contain a demineralized water/glycol mixture including Closed Cooling Water,	CS	SP6	WS
CC-4	Utility Systems	Potable Water	SS	ASTM	CP
CC-5	Oil Systems	Lubricating Oil Supply, Hydraulic Oil, Seal Oil	SS	PFI	CP
CC-6	Oil Systems	Lubricating Oil Return	CS	SP8	OS
CC-7	Compressed Gas Systems	Hydrogen, Carbon Dioxide, Instrument Air, Nitrogen	CS	PFI	VCI
			SS	PFI	CP
CC-8	Chemical Systems	Ammonia, Acid, Caustic, etc.	Varies	PFI	CP
CC-9	Natural Gas Systems	Fuel Gas (Natural Gas)	CS	SP6	VCI
			SS	PFI	CP
CC-10	Fuel Oil Systems	Fuel Oil	CS	SP6 [5]	VCI

Abbreviations: “CS” = Carbon Steel, "SS" = Stainless Steel

Notes:

1. Blast cleaning shall only be performed on piping NPS 4 and larger. Piping less than NPS 4 shall be internally cleaned in accordance with PFI ES-5, Standard Cleaning and be free of debris.
2. Internal pipe cleaning method is:
   SP3 - Power tool cleaning
   SP6 - Commercial blast cleaning
   SP8 - Pickling
   PFI - No special cleaning required / PFI-ES-5 standard clean
   ASTM – ASTM A380 or A967
3. Internal pipe Rust Preventative:
   WS – Water soluble preservative
   SFWS – Silica free water soluble preservative
   OS – Oil soluble preservative
   VCI – Vapor Corrosion Inhibitor
   CP – Coating Prohibited
4. The systems listed are examples only and do not represent an exhaustive list. Seller shall confirm cleanliness requirements with Buyer if system is not included in the system examples list.
5. Fuel Oil piping shall be internally commercially blasted using a manufactured abrasive such as glass beads or other Buyer approved equal. Naturally occurring abrasives (such as silica sand) and Byproduct abrasives (such as coal furnace slag) shall not be used.

12. GALVANIZING

12.1 After fabrication and before assembly, all structural steel framing, grating and stair treads, handrails, ladders and cages and all related fasteners shall be degreased, cleaned

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of rust and scale, prefluxed, and hot-dipped galvanized. The zinc (hot galvanized) coatings applied to the fabricated products shall be in accordance with ASTM A123 and all of the incorporated specifications and recommended practices of the ASTM referenced therein, except as otherwise required or permitted herein. Additionally, hot-dip galvanizing and fabrication of items for hot-dip galvanizing should conform to the standards and guidelines set forth in AHDGA/ZI Manual. Materials to be galvanized shall be prepared for galvanizing by being properly cleaned, pickled, rinsed, and dried. The cleaned materials shall be galvanized before any rusting occurs.

12.1.1 Reinforcing steel bar requiring galvanizing shall be hot dip galvanized by either ASTM A767 for batch galvanizing or ASTM A1094 for continuous galvanization.

12.2 Parts to be galvanized shall be designed for erection with bolts, pins, anchor bolts, clips, etc. to minimize field welding, drilling, or any operation that would damage galvanizing.

12.3 Bolts, nuts, washers, anchors, stops, banding, and other appurtenances (except stainless steel) required for assembling galvanized parts shall also be galvanized. Anchor rods shall be hot dipped galvanized. All bolts shall be Zinc-Coated (Mechanically galvanized), per ASTM A153. Nuts shall be Zinc Coated (Mechanically galvanized), ASTM A153 Class C. Washers shall be Zinc-Coated (Mechanically galvanized), ASTM A153 Class C. Anchor rod standard nuts shall be Zinc-Coated, ASTM A153 Class C. Anchor rod standard washers shall be Zinc-Coated, ASTM A153 Class C. Guardrail/handrail shall be hot dipped galvanized. Safety swing gates shall be galvanized. Floor grating and stair treads shall be galvanized per ASTM A123.

12.3.1 All galvanized nuts shall be provided with a lubricant which shall be clean and dry to the touch in accordance with supplemental requirements of ASTM A563.

12.4 Galvanized faying surfaces of bolted connections using ASTM F3125 Grade A325 or A490 bolts shall be galvanized in accordance with the requirements of ASTM A123. Power or hand wire brushing is not permitted. Faying surfaces are defined in the "Specification for Structural Joints Using High-Strength Bolts."

12.5 Structural steel assemblies, including welding and quality inspections, shall be completed prior to galvanizing. Stair stringers and treads shall be assembled after galvanizing. All grating, stair treads, ladders, floor plates, banding bars, bolts, nuts, washers, and other members shall only be galvanized after all shop fabricator processes have been completed.

12.6 Precautions should be taken to avoid distortion or warpage of members during galvanizing in accordance with applicable ASTM standard. The procedure suggested in ASTM A384 and on pages 26 and 27 of AHDGA/ZI Manual shall be observed. Material failing to meet the required criteria for straightness and length shall be subject to rejection.

12.7 Pipes and tubes intended to be galvanized shall be galvanized on the inside and outside surfaces.

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12.8 All galvanized components that are to receive a finish paint coating shall have the surface prepared in accordance with ASTM D6386.

12.9 Seller shall insure that there are no cracks at re-entrant corners of coped W shapes. If cracks are found, they shall be repaired prior to shipment. Seller's repair procedure shall be submitted to Buyer for review prior to installation. Galvanized material with metal cracks is unacceptable. Seller shall repair or replace unacceptable material.

12.9.1 For repairs, fill vent holes and grind smooth after galvanizing. Repair with galvanizing repair paint when completed. Uncoated areas of steel after initial hot dip galvanizing an/or mechanical damage during handling and erection shall be repaired in accordance with the requirements of ASTM A780 and Annex A2 of ASTM A780 with the following exceptions:

12.9.1.1 Areas to be repaired shall be power disk sanded to bright metal. To ensure that a smooth reconditioned coating can be affected, surface preparation shall extend into the undamaged or acceptable galvanized area by not less than one inch all around to ensure continuity of coating.

12.9.1.2 Touch-up paint shall be an organic cold galvanizing compound having a minimum of 93% zinc dust by weight in the dry film. Touch-up on galvanized surfaces where galvanizing has been removed or otherwise damaged shall be coated per CS-107.

12.9.1.3 The paint shall be spray or brush applied until a total dry film thickness of 4 mils minimum has been achieved. Two separate coating applications shall be made with each application achieving a minimum dry film thickness of 2 mils. A finish coat of aluminum paint shall be applied to provide a color blend with the surrounding galvanizing.

12.9.1.4 Coating thickness exclusive of the finish coat shall be verified by measurements with a magnetic or electromagnetic gauge.

12.9.2 The use of zinc-based solders or metallizing by zinc spray for touch-up and repairs is not permitted.

12.9.3 Any wet storage stain shall be removed by the Seller if formed and discovered prior to leaving the galvanizing plant. Wet storage stain shall be removed to prevent premature failure of the coating. Wet storage stain shall be removed as follows:

12.9.3.1 The objects shall be arranged so that their surfaces dry rapidly.

12.9.3.2 Remove light deposits with a stiff bristle (not wire) brush. Heavier deposits are to be removed by brushing with an acidic based metal cleaner. The surfaces cleaned shall be thoroughly rinsed with water.

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12.9.3.3 A coating thickness check must be made in the affected areas to ensure that the zinc coat remaining after the removal of wet storage stain is sufficient to meet or exceed the requirements of the Specification. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

12.9.3.4 Failure to meet Specifications requirements after removal of wet storage stains shall require that the affected materials be stripped and regalvanized. These same materials are subject to re-inspection and retest.

12.10 Seller shall determine the size, location and shape of fill, drain, and vent openings in the product in accordance with the recommendations of ASTM A385 for closed sections such as pipe and structural tubing and open sections such as rolled shapes, plates and built-up members. Such openings shall be documented on the detailed shop drawings by specifying the size, location, and shape as required on each member.

12.11 Seller shall completely seal the perimeter of overlapped member surfaces that are in contact with continuous welds prior to galvanizing. Where design welds are required for overlapped members, then only the balance of the overlapped perimeter shall be sealed. Unsealed overlapping areas may trap galvanizing process acids which can escape to discolor or damage the galvanized coating. Seller shall determine the venting requirements for sealed overlapping surfaces. Vent holes for such cases shall be provided, if necessary, in only one member of the overlapped area.

12.12 Seller shall coat materials with safety colors as specified above in this Section.

13. INSPECTION

13.1 General

13.1.1 All instruments used in inspection activities (e.g., thermometer, pyrometers, hygrometers, thickness gauges, profile gauges, and holiday detectors) shall be furnished in proper working order and calibrated before use with supporting documentation.

13.1.2 Dew point, relative humidity, and surface temperature shall be determined before surface preparation. Readings are required at 4-hour intervals or at other time intervals approved by the Buyer and documented.

13.1.2.1 Alternatively, continuous monitoring of dew point and relative humidity may be performed using systems established or accepted by the Buyer and documented.

13.1.3 Air supply for blast cleaning, pneumatic tools, and spray equipment shall be tested for oil and water contamination in accordance with ASTM D4285.

13.1.3.1 Testing shall be performed at the beginning and end of each work shift and at not less than 4-hour intervals unless approved by the Buyer. If contamination is discovered:

a) All necessary corrective actions shall be made and the air supply retested.

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b) Surfaces determined to have been blasted with contaminated air shall be cleaned with solvent and re-blasted with clean air and abrasive.

c) Coatings determined to have been applied using contaminated air shall be removed and reapplied using clean air.

13.1.4 Adhesion test method shall be approved by the Buyer. Adhesion may be assessed by means of portable pull-off adhesion tester in accordance with ASTM D4541 or ISO 4624 or one of the appropriate tape tests in accordance with ASTM D3359 or ISO 2409.

13.1.4.1 Acceptable adhesion classifications or pull-off strengths shall be in accordance with coating material manufacturer's recommendations and approved by the Buyer.

13.1.5 Completed paint job shall pass inspection by the Buyer's inspector(s). Any work found not to be in accordance with the requirements specified herein shall be corrected.

13.1.6 DISCONTINUITY (HOLIDAY) TESTING

13.1.6.1 Seller shall perform in-shop discontinuity (holiday) testing on all Seller coated buried pipe and equipment prior to shipment. Holiday testing shall be performed in accordance with NACE SP0188, ASTM D5162, or NACE SP0490. Holiday Test Method used is determined by the coating thickness and coating manufacturer's recommendations. Seller shall repair all holidays and damage detected during the test to ensure a holiday-free surface prior to shipment.

13.1.6.2 Buyer shall perform a field discontinuity (holiday) test on all buried pipe and equipment prior to backfilling or lowering into the ditch (including testing at coating holdback and field repair locations). Holiday testing shall be performed in accordance with NACE SP0188, ASTM D5162, or NACE SP0490. Holiday Test Method used is determined by the coating thickness and coating manufacturer's recommendations. Buyer shall repair all holidays and damage detected during the test to ensure a holiday-free surface.

14. SHIPPING, HANDLING, AND STORAGE

14.1 Coated items shall not be handled or moved until all coatings have been properly dried or cured in accordance with the coating manufacturer's instructions unless otherwise specified.

14.1.1 Coated items relying on the applicable operating service for curing shall have additional measures such as block-outs for strapping or other predetermined handling procedures to prevent damage to coating during shipping, handling, and installation.

14.2 Coated items shall be handled with non-metallic equipment such as wide belt slings, web belts, and wide padded skids selected to prevent damage to the coating.

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14.3 Do not use handling equipment that can cause damage to the coating. Items such as chains, cables, hooks, tongs, metal bars, and narrow skids shall not be permitted to come in contact with the coating.

14.4 Dragging or skidding coated pipe shall not be permitted.

14.5 Coated items shall be loaded, padded, and secured for transport in a manner such that the coating will not be damaged in transit.

14.6 Coated items shall be transported and stored using means to avoid contact with known dissimilar reactive materials.

14.7 Coated items shall be separated so that the items do not bear against each other.

14.8 Coated items shall be stacked off the ground using suitable means (e.g., parallel height ridges of rock-free sand, wooden timbers placed under the uncoated pipe ends, etc.) to avoid damage to the coating.

14.9 Shipping braces, temporary steel, shipping fixtures and all other pieces that shall be removed prior to installation shall be finish painted safety pink.

14.10 Remove all blast media from components prior to shipment.

14.11 All equipment and components that have been hydrostatic tested shall be fully drained of test fluid and completely dried prior to shipment. All openings in pipe and equipment shall be covered.

14.12 All flange faces, machined surfaces, and threads shall be cleaned and protected from damage during shipment. Flange faces and machined surfaces shall be protected with wood, plastic, or metal covers. Couplings and threaded openings shall be protected by steel pipe plugs or by plastic protectors. Open ends of piping and tubing shall be cleaned and sealed and taped or supplied with end caps prior to shipping.

14.12.1 A rust preventative weldable primer shall be applied to all non-stainless steel metallic flange faces prior to shipment using Cortec® VpCI 368 or Buyer approved equal substitute. A rust preventative is not required for stainless steel.

END OF SECTION

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