

Steel Structures Painting Council

COATING SYSTEM GUIDE NO. 23.00

Guide for Thermal Spray Metallic Coating Systems

1. Scope

1.1 This Guide covers the requirements for thermal spray metallic coatings, with and without sealers and topcoats, as a means to prevent corrosion of steel surfaces.

1.2 Types of metallic coatings included are pure zinc, pure aluminum and zinc/aluminum alloy, 85% zinc/15% aluminum by weight.

1.3 This system is suitable for use on structures or parts thereof exposed in SSPC Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water) and 2C (fresh water immersion). It may be used in Environmental Zones 2B (frequently wet by salt water), 2D (salt water immersion), 3A (chemical, acidic), 3B (chemical, neutral) and 3C (chemical, alkaline) with proper sealing/topcoating (see Section 6 and Note 11.2 of this Guide).

1.4 This document is intended to serve as a guide for preparing specifications for thermal spray applications.

2. Description

2.1 This coating system consists of surface preparation by abrasive blast cleaning, application of metallic coating and, where specified, sealer or sealer plus topcoat. This Guide also includes inspection and acceptance requirements.

2.2 **DEFINITION:** Thermal spraying is a process wherein finely divided metallic materials are deposited in a molten or semi-molten condition to form a coating. The coating material may be in the form of powder or wire. **NOTE:** Only wire application is covered by this Guide.

3. Reference Standards

3.1 The standards referenced in this Guide are listed in Sections 3.3 to 3.67.

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

3.3 STEEL STRUCTURES PAINTING COUNCIL (SSPC) SPECIFICATIONS:

PA 1	Shop, Field, and Maintenance Painting
PA 2	Measurement of Dry Paint Thickness with Magnetic Gages
PA Guide 3	A Guide to Safety in Paint Application

Paint 27*	Basic Zinc Chromate-Vinyl Butyral Wash Primer
SP 1	Solvent Cleaning
SP 5	White Metal Blast Cleaning
SP 10	Near-White Blast Cleaning
Vis 1-89	Visual Standard for Abrasive Blast Cleaning

3.4 MILITARY STANDARDS:

MIL-W-6712	Military Specification: Wire, Metalizing
DOD-P-15328	Primer (Wash) Pretreatment
DOD-STD-2138 (SH)	Metal Sprayed Coating Systems for Corrosion Protection Aboard Naval Ships

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

D 4417	Standard Test Methods for Field Measurement of Surface Profile of Blast-Cleaned Steel
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3.6 AMERICAN WELDING SOCIETY (AWS) STANDARD:

TS 85 Recommended Safety Practices for Thermal Spraying, 1973.

4. Surface Preparation

4.1 **PRECLEANING:** A steel structure may require solvent or steam cleaning (SSPC-SP 1) or power washing (low- to medium-pressure water jetting) prior to blast cleaning to remove dirt, grease, soluble salts, and other contaminants. This power washing may help to prevent early flash rusting after blast cleaning.

4.2 **REMOVAL OF SURFACE DEFECTS:** Surface irregularities interfering with the performance of the coating (e.g., sharp edges and/or carburized edges, cracks, delaminations and pits) shall be removed or repaired.

4.3 **BLAST CLEANING:** The surface shall be abrasive blast cleaned to white metal (SSPC-SP 5). The abrasive type, size, and hardness shall be selected so as to produce an angular surface profile of 2.0-4.0 mils (51-102 microns). The depth of surface profile required depends upon thermal sprayed coating thickness. When specifying greater than 12 mils (305 microns) of thickness, a minimum of 3 mils (76 microns) surface

profile (not to exceed 1/3 total coating thickness) shall be achieved to ensure coating adhesion. **NOTE:** Adhesive strength tends to increase with surface roughness.

4.3.1 Abrasives shall be hard and sharp in order to produce an angular surface profile. The abrasives include, but are not limited to, angular aluminum oxide, chilled iron grit, crushed slag and silica or non-silica sand. Shot or other abrasives producing a rounded surface profile are not acceptable for thermal spraying.

4.3.2 The surface profile will be measured using a surface profile comparator, replica tape or other method suitable for the abrasive being used in accordance with ASTM D 4417.

4.3.3 By mutual agreement of purchaser and applicator, SSPC-SP 10, "Near-White Blast Cleaning," will be acceptable where SSPC-SP 5 cannot be practically attained (i.e., severely pitted steel). Consult SSPC-Vis 1-89 to aid in determining the cleanliness of the blast cleaned steel.

5. Application of Metallic Coating

5.1 STEEL SURFACE: The steel surface to be thermal sprayed shall meet the requirements of Section 4 prior to application of metallic coating.

5.2 ENVIRONMENTAL CONDITIONS: Thermal spray metallic coating shall not be applied to a surface which shows any sign of surface moisture. Thermal spraying shall not be performed when the steel temperature is less than 5°F (3°C) above the dew point.

5.3 EQUIPMENT AND TECHNIQUES: The equipment shall be operated in accordance with the manufacturer's latest written instructions, including but not limited to air pressure, gun/work surface standoff distance and gun angle relative to the work surface. It is necessary to ensure that the semi-molten or plastic particles impinge onto and adhere to the substrate (Section 5.6).

5.3.1 It is recommended that the purchaser establish a prequalification program for contractors. A program is outlined in Section 5 of DOD-STD-2138 (SH).

5.4 SPRAY PATTERN: Spraying shall be performed in a block pattern, typically 2 ft (60 cm) square. Unless otherwise specified, the sprayed metal shall overlap 50% on each pass to ensure uniform coverage. The required coating thickness shall be obtained in multiple layers. Each layer shall be applied at right angles to the previous layer.

5.5 METALLIC COATING THICKNESS: The metallic coating thickness is dictated by the service environment (temperature, pH, immersion or splash zone) and location on the structure.

5.5.1 Typically, the metal coating shall be applied at a minimum of 6 mils (152 microns) for zinc and zinc/aluminum alloy, and 4 mils (102 microns) for aluminum. For most corrosion applications, aluminum is usually sprayed to a maximum thickness of 10 mils (254 microns) without a bond coat. Some

high temperature applications may require 15 mils (356 microns) of aluminum and may need a bond coat for proper adhesion. Zinc does not need a bond coat, and may be sprayed onto structural steel to 14 mils (350 microns) without risk of delamination.

5.5.2 At least one layer of coating should be applied within 4 hours of blasting, or before flash rusting occurs, whichever is sooner. This single layer must cover the peaks of the surface profile. This thin coating is intended to temporarily preserve the surface preparation. Before applying additional sprayed metal to the specified thickness, the first layer of coating shall be visually inspected to verify that the coating surface has not become contaminated. Any contamination between coats must be removed in accordance with the material supplier's written instructions before any additional material is applied. The coating shall be sprayed to achieve the specified thickness as soon as possible.

5.6 METALLIC COATING PROPERTIES: The coating shall be firmly adherent in accordance with the "Visual Examination Requirements of DOD-STD-2138 (SH); i.e., free of spots, lumps, blisters, chips or loosely adhering particles, etc.

5.7 ALTERNATIVE SYSTEM: As agreed between the purchaser and applicator, where adequate surface preparation, or the required gun/work piece standoff distance cannot be achieved, an alternative coating system should be applied.

6. Applications of Wash Primers, Sealers, and Topcoats

6.1 GENERAL: Bare metallic coatings provide long-life protection when properly applied. Sealers and topcoats provide extended corrosion protection and customized appearance, but may require earlier maintenance to maintain uniform appearance. Thermal sprayed steel should be sealed or sealed and topcoated under any of the following conditions (see Note 11.5):

- a) the environment is very acidic or very alkaline (normal pH range for pure zinc is 6 to 12 and for pure aluminum 4 to 11);
- b) the metallic coating is subject to direct attack by specific chemicals;
- c) a particular decorative finish is required;
- d) additional abrasion resistance is required;
- e) frequent salt water spray, or splash or immersion service; and
- f) frequent fresh water spray, or splash or immersion service, excluding potable water.

If required, a sealer or sealer/topcoat (with or without wash primer, see Section 6.2), shall be applied as specified by the purchaser. Refer to Section 7.2 for typical paint materials. An experienced thermal spray applicator may be able to furnish advice regarding sealers and topcoats.

6.2 WASH PRIMER: The wash coat primer is used in combination with a sealer or topcoat. The wash primer is de-