

SSPC: The Society for Protective Coatings

Technology Guide 22

Use and Retention of Pre-Construction Primers on Steel In Shipbuilding

1. SCOPE

This guide document provides the specifier and user with information regarding the use of pre-construction primers (PCPs) on structural steel in shipbuilding. It provides background on the reasons to use and retain PCPs, the types of PCPs and their application and inspection, and the secondary surface preparation processes that are used when PCPs are retained in the final, compatible primary coating system. While this document contains details specific to the shipbuilding industry, the technical concepts related to the application and retention of PCP may apply to other industrial applications.

2. BACKGROUND AND USE

A PCP is a very thin-film primer coating applied to blast cleaned steel plates and shapes to provide preservation of the blasted steel during the shipbuilding process. It may also be referred to as a shop primer, or a pre-fabrication primer. Typical film thickness for weldable preconstruction primers is 15 to 25 micrometers [μm] (0.6 to 1.0 mils). Thicknesses beyond this range may be used for other situations such as non-weldable preconstruction primers with an extended corrosion requirement. A PCP is not a suitable substitute for the primer that is part of the primary coating system. Its function is purely to preserve the steel during the construction period (which may range from 6 months to 18 months or more), while allowing welding to be performed directly over (or through) the PCP without requiring the added expense to remove it. Unless otherwise required by the owner or specifier for special service environments, in most cases the PCP does not need to be removed in order to achieve acceptable coating system performance, provided that it is suitably prepared/cleaned and topcoated with a compatible primary coating system.

For commercial vessels, the use of pre-construction (shop) primers in seawater ballast tanks and the void spaces of double-skin hull bulk carriers and in the cargo oil tanks of crude oil tankers is discussed in the International Maritime Organization (IMO) Performance Standards for Protective Coatings (PSPC). The American Bureau of Shipping (ABS) Coating Performance Standard (CPS) Guide for Class Notation also discusses the use of PCPs in relation to the IMO PSPC seawater ballast tank standard (PSPC-SWBT).

3. REFERENCED DOCUMENTS

The latest issue, amendment, or revision of the referenced documents in effect on the date of publication of this Guide is shown below and shall govern unless otherwise specified.

3.1 SSPC STANDARDS

SSPC-Paint 30 (2004)	Weld-Through Inorganic Zinc Primer
SSPC-SP 10/ NACE No. 2 (2007)	Near-White Blast Cleaning
SSPC-SP 7/ NACE No. 4 (2007)	Brush-Off Blast Cleaning
SSPC-SP 15 (2013)	Commercial Grade Power Tool Cleaning
SSPC-SP 3 (2004)	Hand Tool Cleaning
SSPC-SP 1 (2015)	Solvent Cleaning

3.2 ASTM STANDARDS¹

F21 (2014)	Standard Test Method for Hydrophobic Surface Films by the Atomizer Test
F22 (2013)	Standard Test Method for Hydrophobic Surface Films by the Water-Break Test

3.3 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO) STANDARDS²

ISO 8501-1 (2007)	Preparation of steel substrates before application of paints and related product—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
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¹ ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. For referenced ASTM standards, visit the ASTM website, <<http://www.astm.org>>. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website

² International Organization for Standardization (ISO), Case Postale 56, Geneva CH-1211, Switzerland. In the United States, ISO standards may be obtained from the American National Standards Institute (ANSI) at <<http://www.ansi.org>>

ISO 8502-9 (1998)	Preparation of steel substrates before application of paints and related product—Tests for the assessment of surface cleanliness – Part 9 Field method for the conductimetric determination of water-soluble salts
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3.4 NACE INTERNATIONAL STANDARDS³

NACE SP-0178 (2008)	Design, Fabrication and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service
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3.5 INTERNATIONAL MARITIME ORGANIZATION⁴

IMO Resolution MSC. 215(82)	Performance Standard for Protective Coatings for Dedicated Seawater Ballast Tanks in All Types of Ships and Double Side Spaces of Bulk Carriers (PSPC-SWBT)
IMO Resolution MSC. 288(87)	Performance Standard for Protective Coatings for Cargo Oil Tanks of Crude Oil Tankers (PSPC-COT)

3.6 AMERICAN BUREAU OF SHIPPING⁵

ABS Publication 153	Guide for the Class Notation, Coating Performance Standard (CPS), July 2013
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3.7 U. S. DEPARTMENT OF DEFENSE STANDARD:⁶

MIL-PRF-23236 (2009)	Performance Specification, Coating Systems for Ship Structures
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3.8 UNITS OF MEASURE: This guide makes use of both the ASTM SI 10, “American National Standard for Metric Practice” International System Units (SI) units and U.S. Customary units. SI units are presented first, with U.S. Customary units shown in parentheses. The values for each system of units should not be considered exact conversions or equivalents, and each system should be used independently of the other. The term “mil” in this guide represents units of 0.001 (one-thousandth) inch.

4. DEFINITIONS

Primary Surface Preparation: Surface preparation that is performed on steel plates, extrusions, or other pre-fabricated shapes before PCP application.

Secondary Surface Preparation: Secondary surface preparation is defined as the collection of processes associated with cleaning, steel finishing/dressing treatments, and coating surface preparation that are performed on a structural assembly that has previously been subject to primary surface preparation, coated with PCP, and subsequently fabricated into larger vessel blocks/modules or the final product. It is performed prior to the application of the final specified primary coating system.

Primary Coating System: The primary coating system is the final specified coating system that is applied to the structure, over properly cleaned and prepared PCP as well as any major module/block erection welds or any other welds. The primary coating system may consist of a primer coat, a topcoat, and if specified, one or two intermediate/stripe coats applied to edges and welds.

Note: There may be a variety of primary coating systems required over the same PCP in different areas of the vessel, depending on the expected service life and the intended operating environment. All of them should be approved by the owner or specifier prior to the start of the job as being compatible with the PCP in the intended service environment. For areas of vessels subject to Classification Society⁷ rules and the IMO PSPC, the complete coating system (pre-construction primer and primary coating system) may require a Type Approval Certificate from the applicable Classification Society. PSPC-compliant coating systems have a minimum target useful coating life of 15 years.

5. PRE-CONSTRUCTION PRIMER MATERIALS

The two major types of PCPs currently in use are epoxies (organic), and inorganic zinc silicates. Both types may be commercially available as solvent-borne or water-borne coatings.

Epoxies are compatible with many primary coating systems, which also are predominantly epoxies. However, epoxies are typically removed from weld areas as they may burn or char at welding temperatures and can interfere with the weld quality. Epoxy PCPs are available in low-VOC formulations.

Inorganic zinc silicates are the current state-of-the-art PCPs. They provide temporary corrosion protection, have high heat resistance, and are compatible with most welding processes. Inorganic zinc silicate PCPs are available in low-VOC formulations. PCPs that comply with the PSPC are also to be free of any added corrosion inhibitors.

³ NACE International, 15835 Park Ten Place, Houston, TX, 77084, 1 281-228-6200. Information at <<http://www.nace.org>>

⁴ International Maritime Organization, 4 Albert Embankment, London SE1 7SR United Kingdom. Information at <<http://www.imo.org/Publications/Pages/Home.aspx>>

⁵ American Bureau of Shipping, ABS Plaza, 16855 Northchase Drive, Houston, Texas 77060, United States Tel: 1-281-877-5800. Information at <<http://www2.eagle.org/en.html>>

⁶ U. S. DoD standards are available at <<http://quicksearch.dla.mil>>

⁷ A Classification Society is one of a group of non-governmental organizations that establishes and maintains technical standards for the construction and operation of ships and offshore structures.

One advantage of a zinc silicate PCP is that the corrosion protection can be tailored to particular protection requirements by manipulating the zinc content. Most suppliers of inorganic zinc PCP will have several formulas with zinc loads ranging from 45% to over 65% by weight. Adjusting the zinc content is a trade-off between corrosion protection and weldability. High production rate shipyards will often request a lower zinc load as that has the least effect on cutting and welding, while sacrificing some degree or duration of corrosion protection.

SSPC-Paint 30 addresses weld-through inorganic zinc primers. PCPs that comply with SSPC-Paint 30 are required to have a minimum of 65% by weight of zinc in the total film solids, although the standard notes that PCPs with less zinc may pass its performance requirements. Refer to SSPC-Paint 30 for other properties and information concerning both the liquid coating and the cured paint.

6. MATERIAL PROPERTIES

6.1 WELDABILITY: The ability to weld through a PCP without removing it is one of the major economic advantages of PCP use. Good weldability is generally characterized as the ability of the primer to produce little or no porosity in a weld. The type of PCP may also influence both spatter formation and adhesion, and the resistance to thermal degradation due to cutting and welding operations. Epoxy PCPs are not resistant to high temperatures and are subject to burn-back near a weld or on the other side of a steel plate opposite a fillet weld to attach a stiffener. Zinc silicate primers can withstand 800 °C (1472 °F) for short periods of time, and are much less prone to thermal damage.

Some owners/specifiers may impose special requirements on allowable filler metals/electrodes, and post-weld inspection requirements for porosity when using weld-through PCPs, depending on the grade of steel. Welding specialists should be consulted to determine proper procedures.

6.2 CORROSION PROTECTION: The corrosion protection of the PCP is a function of the quality of the surface preparation and application, film thickness applied, environment, and degree of damage during storage and construction. In general, zinc silicate PCPs will perform better than those with little to no zinc dust, during atmospheric exposure. Primers designed to be applied at a lower DFT may require a higher zinc content to achieve an equivalent degree of corrosion protection.

6.3 ABRASION/MECHANICAL DAMAGE RESISTANCE: In a shipbuilding environment, plates, shapes, panels, and modules are frequently subjected to mechanical contact and abrasion from conveyor rollers, handling equipment, stacking procedures, dragging of hoses and other equipment, and foot traffic. Therefore, a PCP that has good resistance to abrasion and mechanical damage is highly desirable, since it will result in less coating damage and subsequent corrosion that will have to be repaired during secondary surface preparation.

6.4 DRY TO HANDLE AND CURE TIME: A rapid dry-to-touch and handling time is a very important property of

PCPs in a shipbuilding environment. When the steel plates and shapes are being cleaned and coated in an automated conveyor facility, they need to be able to be handled and moved as soon as they emerge from the line. It is important to recognize that the curing process continues after the coating is acceptable for handling, and that the PCP must be completely cured before topcoating. Consideration needs to be given to stacking and storing coated steel that has achieved only a “dry to touch” condition. Proper cure can be impeded if coated parts are stacked without spacers or stored where environmental conditions are outside the manufacturers requirements, or water is allowed to pool on primed surfaces before complete cure has been achieved. In extreme cases, proper cure may never be achieved and premature breakdown can occur with improper stacking or storing during the cure process.

7. SELECTION OF A COMPATIBLE PRIMARY COATING SYSTEM

The key factors in selecting a compatible primary coating system are:

- The coating system must be compatible or appropriate for the intended service environment, including the desired service life and the owner or specifier’s coating maintenance strategy.
- The coating system manufacturer/vendor should verify compatibility of the primary coating system with the retained PCP.
- Appropriate approvals of the system compatibility must be in place. This may require regulatory, Classification Society, Naval Authority, or other approvals, obtained via documented past performance, or by satisfactory completion of a test program.

7.1 INTENDED SERVICE ENVIRONMENT: The criteria for selecting any primary coating system to protect a structure are its compatibility with the intended service environment, and its ability to provide corrosion protection for a required or desired length of time. An in-depth discussion of all of the pertinent factors is beyond the scope of this guide.

7.2 COATING MANUFACTURER PRODUCT COMPATIBILITY: PCP can be retained in almost any area of the vessel, internal or external. For many coating applications, compatibility between the PCP and the primary coating for other areas can be verified by the coating manufacturer. For critical applications such as tank coatings, independent test data may be required. Coatings over retained PCPs for potable water tanks may require separate approval from NSF International.⁸ Liquid cargo tank linings may require the removal of PCPs depending on the cargo and lining. Inorganic zinc coatings should never be applied over retained pre-construction primers. Note that it is not uncommon to have one supplier for PCP and another for the primary coating system. While the choice of PCP is vital from a corrosion protection or welding perspective, PCPs

⁸ NSF International, P.O. Box 130140, 799 N. Dixboro Road, Ann Arbor, MI, 48105-1405, Phone 1-800-673-6275 <<http://www.nsf.org>>