

Properly Prepared

BY ERIKA WINTERS-DOWNEY, S.E.

There's more than one way to surface prep a member.

WE ALL WORK HARD TO MAKE THE STRUCTURES WE DESIGN PERFORM WELL FOR OUR CUSTOMERS. But in addition to meeting safety and serviceability requirements, appearance can also be an important measure of success. In order for primers and paints to work as intended, structural steel must go through a surface preparation process. Specifying the correct level of surface preparation is key to achieving the finished look you want.

Why is steel prepared?

When contaminants such as dirt, rust, salts, or oil are left on the steel's surface and painted over, they have the ability to draw in moisture, which will chip the paint and rust the steel. The most common cause of painting and coating failure is improper surface preparation. A level of surface preparation that complements the paint specification ensures that the primers and paint will uniformly adhere to the steel and last for the intended service life. Common surface preparation techniques include solvent cleaning, wire brushing, power tooling, and abrasive blasting.

Why are there different preparation categories?

The level of surface preparation required will vary based on the end use of the steel and the coatings desired. Steel members that will remain enclosed usually require no painting and will receive minimal surface preparation. Pieces that require a high-end finish will require a more rigorous preparation to ensure that the product adheres uniformly. Members that are to be galvanized go through a pickling process to chemically clean them of any surface oils, dirt, and rust before being galvanized. Finally, members that will be located in severe environments, such as coastal areas, industrial facilities, or high-humidity areas, require high-end coatings and higher levels of surface preparation.

What must I include on my drawings and specifications?

Members that are to be prepared and painted must be designated in the contract documents. In addition, the level of surface preparation and coat-



A worker uses a wire brush to prepare a member to SSPC-SP2. Photo courtesy of Atlas Iron Works, St. Louis.

ing information must be included in the specifications accompanying the documents.

Does AISC give recommendations about surface preparation? If not, who does?

Section 6 of the AISC *Code of Standard Practice* (COSP) states that steel that is to remain unpainted “shall be cleaned of oil and grease with solvent cleaners, and of dirt and other foreign material by sweeping with a fiber brush or other suitable means.” Steel that is to be painted must be prepared to a minimum of SSPC-SP2 (Hand Tool Cleaning).

The COSP addresses AESS in Section 10. This section notes that weathering steel must be prepared to category SSPC-SP6 (Commercial Blast Cleaning). This is done to remove scale that prevents the material from generating the even patina it is chosen for. However, nowhere in this section are guidelines given for general surface preparation of AESS members. Levels of preparation beyond SSPC-SP2 must be specified by the designer.

Industry standards governing the description of surface preparation categories are published by the Society for Protective Coatings (SSPC). The *Steel Structures Painting Manual Volume 2, Systems and Specifications* gives detailed descriptions of each surface preparation category. The SSPC also publishes its VIS series of standards; these are pictorial standards that govern visual inspection of prepared steel.



Erika Winters-Downey is an AISC regional engineer based in Kansas City, Mo.



A worker prepares a member to category SSPC-SP3. Photo courtesy of Atlas Iron Works, St. Louis.

What is "surface profile" in reference to prepared steel?

Surface profile refers to the depth and shape of the microscopic pits and peaks that make up the steel surface. The depth and shape can be varied to some degree by the surface preparation chosen and the abrasive media used. Some high-performance coatings adhere better to a deeper or more angular profile. The profile depth can be measured and is quantified in mils. Surface profile is also commonly referred to as "anchor profile" or "anchor pattern." The abrasive media must be clean so as not to redeposit oil on the steel. Blasting with abrasives can either be done with commercial rotary blasting machines or with nozzles.

What are the different categories of surface preparation?

A basic description of the different standards is as follows:

SSPC-SP1 – Solvent Cleaning. Oils used in various cutting and drilling machines are deposited on the steel. These must be cleaned off prior to applying any coatings. The solvent cleaning process uses an organic solvent that is either wiped or sprayed on the steel to remove dirt, oil, grease, and other contaminants from the surface of the steel. This can be followed with detergents or steam cleaning. This step is integral because it is the only surface preparation process that removes oil and grease from the steel. Other processes will roughen the steel but not remove oil and grease.

SSPC-SP2 – Hand Tool Cleaning. Hand tool cleaning is usually done with a wire brush or sandpaper. This process will remove loose surface rust and mill scale but is not intended to remove strongly adherent rust. This preparation is generally not adequate for structural steel that will remain exposed. This method is

often used to spot clean areas of a structure that might have rusted, at regularly scheduled maintenance times. It does not require a large working area or produce as much dust or noise as power tool cleaning. As a result, it can be performed in higher profile areas without disturbing the surroundings. Oil-based alkyd paints and epoxies work well with hand tooled preparation.

SSPC-SP3 – Power Tool Cleaning. This level of preparation will produce the same results as SSPC-SP2, but uses power tools such as grinders or sanders instead of wire brushes or sandpaper. The cleaning removes all loose mill scale, weld spatter, rust, paint, and other surface contaminants. This level of preparation is usually a minimum for most AESS steel. The main advantage of this method over hand tool cleaning is time savings when working with larger quantities of material.

SSPC-SP5 - White Metal Blast Cleaning. Blasting to white metal is the most rigorous preparation that can be specified. The surface shall be completely free of all contaminants; no surface contaminants may be visible. These include oil, grease, dirt, rust, paint, mill scale, and oxides. In a 9-sq.-in. area, no rust staining can be present. Blasting is done in a rotary blaster or with compressed air through hand-held nozzles. Small abrasives of metal shot or mineral grit are used.

SSPC-SP6 - Commercial Blast Cleaning. This process is common for AESS steel that will receive a high-end finish. It is more intense than brush-off blast cleaning but not as rigorous as near-white or white metal blast cleaning. No surface contaminants may be visible. In a 9-sq.-in. area, no more than 33% of the area can be stained due to rust. It is required for most epoxy primers and polyurethane finish coats.

SSPC-SP7 – Brush-Off Blast Cleaning. This is the least intensive type of blast cleaning. Its main advantages are speed and economy. Tightly adherent contaminants may remain on the surface of the steel.

SSPC-SP8 – Pickling. This process is most commonly seen as one in a series of baths used in preparation for hot-dip galvanizing. The steel is dipped in a series of tanks to cleanse, pickle, and flux the material. The pickling material can be sulfuric or hydrochloric acid. It will provide a chemically clean surface for galvanizing.

SSPC-SP10 – Near-White Metal

Blast Cleaning. This category is more rigorous than commercial blast cleaning but not as rigorous as white metal blast cleaning. It will add significantly to the cost of the preparation, but when done correctly and with a compatible paint system, will provide a longer service life than other systems. No surface contaminants may be visible. In a 9-sq.-in. area, 5% rust staining can be present.

SSPC-SP11 – Power Tool Cleaning to Bare Metal. This method utilizes power tools to remove all adherent contaminants on the surface of the steel. It also has a required surface profile that must be produced. It usually requires impact-based tools rather than rotary-based tools. It is more rigorous than power tool cleaning. It is generally specified if the preparation is to be performed on spot areas in the field where there is no blasting equipment available.

What about steel that is not exposed or painted?

Section 6 of the COSP states that structural steel that does not require shop paint shall be cleaned of oil and grease with solvent cleaners.

Will it help my paint system to specify a more rigorous surface preparation than noted in product standards?

No. It will add to the cost of your project and not increase the surface life of the product.

What other resources are out there?

The Rocky Mountain Steel Construction Association (RMSCA) developed a model specification that addresses some common surface preparation and coatings concerns. This specification goes beyond the COSP guidelines as an example of a specification that can be adapted to a job with high-end requirements. A cost matrix is included at the rear of this specification that provides guidelines as to the impact that a certain action might have on the fabrication cost of the member. You can find the model specification online at www.modernsteel.com/aess2003. The *Journal of Protective Coatings and Linings* (www.sspc.org/books/journal.html) and AISC's online Engineering FAQs (www.aisc.org/faq) are another couple of resources to search.

How does this affect my project's bottom line?

Higher levels of surface preparation

incur more costs. Costs vary across the country and even from fabricator to fabricator, depending on the equipment available and the level of experience of shop employees. Many shops don't have commercial blasting equipment available and send out pieces that must be blasted. The cost matrix included in RMSCA's model specification indicates that commercial blast cleaning (SSPC-SP6) will typically incur a 10% to 20% cost increase on the fabrication of those members. Preparing and painting a typical shop prime coat will incur a cost increase of 5% to 10%. Blasting to Category SSPC-SP5 (White Metal) is 4-5 times more expensive than preparing to Brush-Off Blasting (SSPC-SP7) or Power Tool (SSPC-SP3). (JCPL Applicator Training Bulletin, Jan. 2005.)



A member exits a rotary blast machine. Photo courtesy of Zimmerman Metals, Denver.

And finally, a word about unspecified standard shop paint...

A "shop coat" is a lower-end primer intended to provide temporary protection to the steel. A good rule of thumb is that if you aren't specifying a final paint coat, you don't need a shop primer coat. Steel that will remain enclosed for its service life does not need to be shop coated. In the Commentary of Chapter M of the Specification for Structural Steel Buildings, it is noted that upon studying long-standing steel frames, the presence of a shop coat is irrelevant. Specifying a shop primer for aesthetic reasons is unnecessary and will add to the schedule and cost of your project. If the steel is unprotected in the field during erection, there is the chance that it will develop a thin film of "flash" rusting (iron oxide). This is not harmful to the strength or serviceability of the steel. MSC

References

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