



SURFACE PREPARATION



Materials used today in buildings, plant and equipment include mainly mild steel, concrete, brickwork, aluminum, galvanized steel and timber. Steel and concrete are usually selected for areas subject to chemical exposure because of their inherent properties and, furthermore, they may be protected from corrosive action by the proper paint coating. Aluminum, galvanized steel and timber because of their characteristics are used in less demanding areas and they, too, are capable of protection by means of coatings. Irrespective of the material chosen, an adequate degree of surface preparation with due consideration of the environment is essential since it is on this basis that the adhesion of the correct painting system is dependent. It is of supreme importance to consider the following factors in any decision of surface preparation:

- Length of service required.
- The type of exposure:
 - o Normal coastal
 - o Industrial
 - o Rural or tropical atmosphere
 - o Exposed to the elements or under cover
- Nature of chemical exposure:
 - o Continuous or intermittent contact with:
 - o Acids or alkalis
 - o Salt solutions
 - o Condensation
 - o Fumes or fall-out
 - o Immersed or underground conditions



Irrespective of the surface chosen, it is mandatory that before painting all dirt, dust, oil, grease or other loose surface contaminants be removed since it is obvious that paint applied to them will have poor adhesion to the underlying surface and the paint will flake off exposing the substrate to attack, resulting in costly maintenance, unsightly appearance and perhaps failure of the structure. Painting must always be carried out as soon as possible after and usually no later than the same day, as the surface preparation.

The following sections deal with each type of surface grouped under the following headings:

- Steel
- Non-Ferrous
- Non-Metallic

A detailed section covering surface preparation methods for steel is included.

■ Steel

Mild steel for its strength to weight ratio and cheapness is one of the most widely used construction materials. However, it readily rusts and must be painted to prevent this corrosion and to provide to it a decorative appearance.

Mill scale found on new steel is a hard, brittle coating of several distinct layers of iron oxides formed during processing of steel such as hot rolling girders, tank plates and other structural shapes. Usually bluish black in colour, mill scale cracks and fissures readily, and is permeable to both air and moisture. Rusting at the mill scale steel interface occurs and in time the scale sloughs off due to the pressure created by the rust layer. Mill scale is cathodic to the steel substrate and if left in place, corrosion will occur as a result of the electrical potential difference between them.

Rust is an oxide of iron formed by the action of air and water. It is voluminous and occupies one and three-quarter times the volume of the steel from which it originated. Rust forming under a paint coating or through breaks in the coating can burst through and may creep under the coating resulting in flaking so that repair is both difficult and costly.

It may cost a little more for a better surface preparation, but as the paint coating will last many times longer, the overall cost saving in maintenance will justify the initial expense. Other types of steel, such as low alloy steels (e.g. Austen 50), which are selected in areas requiring increased strength, hardness or improved resistance to corrosion, can also be prepared by the following methods.

The most commonly quoted reference standards for the preparation of steel for painting are given by the Steel Structures Painting Council (USA) or in the Swedish Standard SIS 055900

(A) Blast Cleaning

A method of removing rust and mill scale by the physical impact of an abrasive propelled on to the surface by compressed air or by centrifugal force from a multiwheel machine.

Non-metallic abrasives sand, ilmenite or copper slag are used for on site blasting, while in the fabri-



cating shop a combination of round steel shot and steel grit may be used, the shot on impact breaks the mill scale and rust while the grit imparts profile or tooth to be abraded surface. If compressed air blasting is used, the air shall be free of detrimental amounts of water and oil. Adequate traps and separators shall be provided at the compressor.

The various methods of preparing steel for subsequent painting are given in the Steel Structures and Painting Council (SSPC) Standards of the U.S.A.

■ 'Light' or 'Brush Off' Blast Cleaning

- 1 - All surfaces to be coated shall be blast cleaned to a Light or Brush Off finish according to SSPC-SP7 (Sa 1 of Swedish Standards SIS 05 59 00).
- 2 - A Light or Brush Off blast cleaned surface finish is defined as one from which all oil, grease, dirt, rust scale, loose scale, loose rust and loose paint or coatings are removed completely, but tight mill scale and tightly adherent rust, paint and coatings are permitted to remain provided that all mill scale and rust have been exposed to the abrasive blast pattern sufficiently to expose numerous flecks of the underlying metal fairly uniformly distributed over the entire surface. Photographic or other visual standards of surface preparation may be used if required to further define the surface if specified in the contract.

■ 'Medium or Commercial' Blast Cleaning

- 1 - All surfaces to be coated shall be blast cleaned to a Medium or Commercial finish according to SSPC- SP6 (Sa 2 of Swedish Standard SIS 05 59 00).
- 2 - A Commercial blast cleaned surface finish is defined as a surface from which all oil, grease, dirt, rust scale and foreign matter have been completely removed from the surface and all rust, mill scale and old paint have been removed except for slight shadows, streaks or discolourations caused by rust stain, mill scale, oxides or slight, tight residues of rust or paint may be found in the bottom of pits. At least two- thirds of each square cm of surface area shall be free of all visible residues and the remainder shall be limited to the light discolouration, slight staining or light residues mentioned above. Photographic or other visual standards of surface preparation may be used if required to further define the surface if specified in the contract.

■ 'Near White' Metal Blast Cleaning

- 1 - All surfaces to be coated shall be blast cleaned to a 'Near White' metal finish according to SSPC-SP10 (Sa 2.5 of Swedish Standard SIS 05 59 00).
- 2 - A 'Near White' metal blast cleaned surface finish is defined as a surface from which all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter have been completely removed from the surface except for very slight shadows, very slight streaks or slight discolourations caused by rust stain, mill scale, oxides or slight, tight residues of paint or coating that may remain. At least 95% of each square cm of surface area shall be free of all visible residues and the remainder shall be limited to the light discolouration mentioned above. Photographic or other visual standards of surface preparation may be used if required to further define the surface if specified in the contract.



■ 'White' Metal Blast Cleaning

- 1 - All surfaces to be coated shall be cleaned to a White Metal finish according to SSPC-SP5 (Sa3 of Swedish Standard SIS 05 59 00).
- 2 - 2. A White Metal blast cleaned surface finish is defined as a surface from which mill scale all rust and all foreign materials are entirely removed. The surface when viewed without magnification shall be free of all oils, grease, dirt, visible mill scale, rust, corrosion products, oxides, paint and other foreign matter. The colour of the clean surface may be affected by the particular abrasive medium used. Photographic or other visual standards of surface preparation may be used if required to further define the surface if specified in the contract.

Blast Cleaning	SSPC	Swedish Standard SIS 05 59 00	Australian Standard AS 1627-Part4
Light or Brush	SP7	Sa1	Class 1
Medium or Commercial	SP6	Sa2	Class 2
Near White Metal	SP10	Sa2.5	Class 2.5
White Metal	SP5	Sa3	Class 3

Types, sizes and resulting profile of abrasives used in air blast equipment

Abrasive	Maximum Particle Size Passing through Mesh	Height of Profile	
		No.Miles	Microns
Sand, very fine	80	1.5	40
Sand, fine	40	2.0	50
Sand, fine	18	2.5	65
Sand, fine	12	2.8	70
Steelgrit # G-80	40	1.3-3.0	30-75
Iron grit # G-50	25	3.3	85
Iron grit # G-40	18	3.6	90
Iron grit # G-25	16	4.0	100
Iron grit # G-16	12	8.0	200
Steel shot # S-170	20	1.8-.2.8	45-70
Iron shot # S-230	18	3.0	75
Iron shot # S-330	16	3.3	85
Iron shot # S-390	14	3.6	90



(B) Pickling

Pickling (chemical de-scaling) is the removal of mill scale and rust using chemical solutions, usually acids, according to SSPC-SP8. Pickling cannot be used on erected structures and is essentially a process for the workshop. Carried out efficiently it is equivalent to white metal blast cleaning and leaves a relatively smooth surface on which it is often easier to obtain a more even paint coating. Surfaces descaled by chemical treatments are smoother than those produced by blast cleaning and may reduce the adhesion of some paints. With some very high build paint coatings the 'tooth' from a blast cleaning profile may be preferred.

- 1 - Solvent or alkaline cleaning or mechanical methods shall be used initially to remove heavy deposits of oil, grease and dirt. Small quantities of such matter may be removed by the pickling procedures, provided that no detrimental residues reduce the efficiency of the pickling solutions. Weld splatter and slag shall also be removed prior to pickling.
- 2 - A Pickled Steel Surface Finish is defined as one from which all mill scale, all welding scale, all rust and other foreign matter are removed.
- 3- Pickling may be carried out by any of the methods using either acid, alkaline or electrolytic baths, or combination, provided adequate precautions are observed to
 - (a) Ensure sufficient inhibitor has been added to minimize attack on the base metal when pickling in acid solutions.
 - (b) Acid pickling or cathodic treatment methods are not used on steel having a tensile strength greater than 10.25 tonnes per square cm or on the welded areas of low alloy steels as these heat affected zones would approach 10.25 tonnes per square cm. This precaution is necessary to prevent hydrogen absorption and subsequent embrittlement, which may result in failure due to hydrogen cracking.
- 4 - The pickled steel surface shall be free of un-reacted or harmful acid or alkali, smut, metal deposits, improperly cleaned areas. Any inhibitive iron phosphate coating shall be firmly adherent to the underlying metal.

(C) Hand Tool Cleaning (SSPC-SP2)

A method of preparing steel surfaces by use of non-power hand tools. Hand tool cleaning removes all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust and paint are considered adherent if they cannot be removed by lifting with a dull putty knife. Hand wire brushing, hand abrading, hand scraping or other similar non-impact methods are acceptable for the removal of loose mill scale, all loose or non-adherent rust and all loose paint. Stratified rust (rust scale) and weld slag must be removed using impact hand tools. Regardless of method use for cleaning, feather edges of remaining old paint so that the unpainted surface can have a reasonably smooth appearance. Hand tool cleaning should only be specified when it is an acceptable method of preparation. It is only suitable for normal atmospheric exposures and interiors when the painting system includes a primer of good wetting ability.



(C) Power Tool Cleaning (SSPC-SP3)

A method of preparing steel surfaces by use of power assisted hand tools. Power tool cleaning removes all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter. It is not intended that adherent mill scale, rust and paint be removed by this process. Mill scale, rust and paint are considered adherent if they cannot be removed by lifting with a dull putty knife. Power wire brushing, power abrading, power impact or other power rotary tools are acceptable means for removal of loose mill scale, all loose or non-adherent rust, and all loose paint. Do not burnish the surface. Use rotary or impact power tools to remove stratified rust (rust scale) and weld slag. Operate power tools in a manner that prevents the formation of burrs, sharp ridges and sharp cuts. Regardless of the method used, feather edges of remaining old paint so that the repainted surface can have a reasonably smooth appearance.

■ Non-Ferrous Metals

Metals included in the group comprise galvanised steel (also Zincanneal, Zinalume, and Galvabond, each of which are steel coatings with zinc and zinc and aluminium mixtures), aluminum and to a lesser extent copper, brass, bronze and zinc and aluminum metal spray.

The selection of galvanized iron and aluminum is increasingly used for roofing and cladding and both have a long history of satisfactory service when used for those purposes. When used in chemical or industrial plants or coastal atmospheric exposures a suitable paint system is necessary to give protection and added durability. The selection of a correct painting system is essential to prevent subsequent failure.

Adequate surface preparation is essential to ensure adhesion of the paint system and surface preparation with non-ferrous surfaces is usually confined to complete cleanliness such as removal of dirt and oil or grease, and this is adequately covered by Australian Standard CK 9.1, Degreasing of Metal Surfaces, which can be summarized as follows:

- 1 - This specification refers to Australian Standard CK 9.1 by which suitable liquids, other than acids are used to remove detrimental foreign matter such as soluble or loosely adherent oil, grease, drawing and cutting compounds, wax, dirt and perspiration from metal surfaces. Large quantities of dirt may first be removed by hand or power tool cleaning.
- 2 - This method may be used for the removal of the above substances prior to the application of paint or in conjunction with other methods of surface preparation such as CK 9.4 for the removal of rust, mill scale or paint.
- 3 - A metal surface prepared to this degree of cleanliness is one, which is then suitable for the subsequent coating and the type of protective coating to be applied.
- 4 - Degreasing may be carried out using any of the methods described in Australian Standard CK 9.1 except that alkaline cleaning is suitable only for steel surfaces. The Solvent Methods of cleaning are suitable for ferrous metals, galvanized iron, copper, tin, brass, bronze, aluminum and its alloys.



■ Surface Preparation Non-Metallic

Concrete, masonry, brickwork and asbestos cement

With brickwork and asbestos cement, the basic requirement is that the surface must be clean and dry. With concrete and masonry, additional problems may be caused by efflorescence, chalk and loose material, and from new or insufficiently aged concrete by:

- 1 - Unbound moisture within the concrete (and in the mortar joints of other masonry) remaining from the original mixing with water,
- 2 - The presence within the material of soluble alkaline substances that are brought to the surface by the outward movement of moisture and deposited as efflorescence, A metal surface prepared to this degree of cleanliness is one, which is then suitable for the subsequent coating and the type of protective coating to be applied.
- 3 - Possible contamination with form oil or concrete curing compounds,
- 4 - Glazed areas resulting from casting against a smooth, non-absorbent form

One method of obtaining a satisfactory surface for painting is to blast clean carefully using a non-metallic abrasive such as sand or ilmenite, taking care not to expose aggregates unduly.

Alternatively the surface may be acid-etched. This treatment consists of treating the surface with dilute acids; either hydrochloric acid diluted with 6 parts, by volume of water, or phosphoric acid diluted with 10 parts, by volume of water. Wet the surface first with freshwater then apply the acid mixture, liberally, by brush or swab so that all areas show a bubbling reaction. After 5-15 minutes rinse off with copious quantities of freshwater and at the same time scrub with stiff brooms to remove loose concrete salts. Allow to dry, avoid any contamination of the etched surface and paint preferably within three days.

After this treatment the concrete should have a clean slightly roughened toothy surface.