Surface Preparation

International Protective Coatings

INTRODUCTION

Proper surface preparation is essential for the success of any protective coating scheme. The importance of removing oil, grease, old coatings and surface contaminants (such as millscale and rust on steel, laitence on concrete and zinc salts on galvanised surfaces) cannot be over emphasised.

The performance of any paint coating is directly dependent upon the correct and thorough preparation of the surface prior to coating. The most expensive and technologically advanced coating system will fail if the surface preparation is incorrect or incomplete.

STEEL

Some of the various methods of surface preparation of steel are briefly described below. For more explicit details and recommendations please refer to full specifications, such as;

1. International Standard ISO 8504:1992(E). Preparation of steel substrates before application of paints and related products - Surface preparation methods.
2. Steel Structures Painting Council (SSPC), Pittsburg, PA, USA. Full range of surface preparation standards.
3. International Standards ISO 8501-1:1988(E) and ISO 8501-2:1994. Preparation of steel substrate before application of paints and related products - Visual assessment of surface cleanliness.
4. Swedish Standard SIS 05 59 00 (1967) - Pictorial Surface Preparation Standards for Painting Steel Surfaces.
5. Shipbuilding Research Association of Japan - Standard for the preparation of steel surface prior to painting ("JSRA" Standard).
6. International Protective Coatings Hydroblasting Standards.
7. International Protective Coatings Slurry Blasting Standards.
8. International Protective Coatings Abrasive Sweep Blasting Standards.

REMOVAL OF CONTAMINANTS

The performance of protective coatings applied to steel is significantly affected by the condition of the steel substrate immediately prior to painting. The principal factors affecting performance are:

a) surface contamination including salts, oils, grease, drilling and cutting compounds,

b) rust and millscale,

c) surface profile.

The main objective of surface preparation is to ensure that all such contamination is removed to reduce the possibility of initiating corrosion so that a surface profile is created that allows satisfactory adhesion of the coating to be applied. Recommended procedures are outlined in International Standard ISO 8504:1992 (E) and SSPC SP Specifications.

DEGREASING

It is essential to remove all soluble salts, oil, grease, drilling and cutting compounds and other surface contaminants prior to further surface preparation or painting of the steel. Perhaps the most common method is by solvent washing, followed by wiping dry with clean rags. The wiping clean is critical, because if this is not carried out thoroughly the result of solvent washing will simply spread the contamination over a wider area. Proprietary emulsions, degreasing compounds and steam cleaning are also commonly used. Recommended procedures are described in International Standard ISO 8504:1992(E) and SSPC-SP1.

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HAND TOOL CLEANING

Loosely adhering millscale, rust and old paint coatings may be removed from steel by hand wire brushing, sanding, scraping and chipping. However, these methods are incomplete, and always leave a layer of tightly adhering rust on the steel surface. Methods for hand tool cleaning are described in SSPC-SP2 and should be to ISO 8501-1:1988 grade St2-B, C or D.

POWER TOOL CLEANING

Generally more effective and less laborious than hand tool cleaning for the removal of loosely adhering millscale, paint and rust. However, power tool cleaning will not remove tightly adhering rust and millscale. Power wire brushes, impact tools such as needle guns, grinders and sanders are all commonly used. Care should be taken, particularly with power wire brushes, not to polish the metal surface as this will reduce the key for the subsequent paint coating. Methods are described in SSPC-SP3 and SSPC-SP11 and should be to ISO 8501-1:1988 grade St3-B, C or D. SSPC-SP11 describes a degree of surface profile which can be achieved by power tool cleaning.

BLAST CLEANING

By far the most effective method for removal of millscale, rust and old coatings, using abrasives such as sand, grit or shot under high pressure.

The grade of blasting suitable for a particular coating specification depends on a number of factors, the most important of which is the type of coating system selected.

The primary standard used in the product data sheets in this manual is ISO 8501-1:1988(E), preparation of steel substrate before application of paints and related products - visual assessment of surface cleanliness. This standard represents a slight extension of the Swedish Standard (SIS 05 59 00 (1967)), which was developed by the Swedish Corrosion Institute, in co-operation with the American Society for Testing & Materials (ASTM), and the Steel Structures Painting Council (SSPC), USA, and is already used on a world-wide scale.

Where appropriate, the nearest equivalent SSPC specification has been quoted on individual product data sheets. It is recognised that the SSPC and ISO standards are not identical, and as a consequence certain product data sheets may show grade Sa2½ (ISO 8501-1:1988) as equivalent to SSPC-SP6, (commercial blast cleaning), whilst others will be equivalent to SSPC-SP10 (near white metal). The selection of these blast cleaning grades will have been assessed using a number of factors including coating type, performance expectation, and in-service conditions.

As a general principle, where products are recommended for immersion or aggressive atmospheric conditions the blasting standard required will be to Sa2½ (ISO 8501-1:1988) or SSPC-SP10, however, when products are recommended for general atmospheric exposure the blasting standard required will be Sa2½ (ISO 8501-1:1988) or SSPC-SP6.

Prior to blasting, steelwork should be degreased and all weld spatter removed. If salts, grease or oil is present on the surface it will appear to be removed by the blasting process, but this is not the case. Although not visible, the contamination will still be present as a thin layer, and will affect the adhesion of subsequent coatings. Weld seams, metal slivers and sharp edges revealed by the blasting process should be ground down, as paint coatings tend to run away from sharp edges, resulting in thin coatings and reduced protection. Weld spatter is almost impossible to coat evenly, in addition to often being loosely adherent, and it is a common cause of premature coating failure.

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The surface profile obtained during blasting is important, and will depend on the abrasive used, the air pressure and the technique of blasting. Too low a profile may not provide a sufficient key for coating, while too high a profile may result in uneven coverage of high, sharp peaks possibly leading to premature coating failure, particularly for thin film coatings such as blast primers. The following table gives a brief guide to typical roughness profiles obtained using various types of abrasive.

Type of Abrasive	Mesh Size	Max. Height of Profile
Very fine sand	80	37 microns (1.5 mils)
Coarse sand	12	70 microns (2.8 mils)
Iron shot	14	90 microns (3.6 mils)
Typical non metallic “copper slag” 1.5-2.0mm grain size	-	75-100 microns (3-4 mils)
Iron grit No. G16	12	200 microns (8.0 mils)

WET ABRASIVE BLASTING/SLURRY BLASTING

Wet abrasive blasting uses a slurry of water and abrasive rather than dry abrasive alone. This has the advantage that the hazards of dust and associated health problems are largely overcome.

A further important advantage is that when wet blasting old, well rusted surfaces, many of the soluble corrosion products in the pits of the steel will be washed out, which will greatly improve the performance of the applied coating system. However, a disadvantage of this technique is that the cleaned steel begins to rust rapidly after blasting. It is therefore common practice to include proprietary inhibitors in the blast water which will prevent this rusting for a sufficient time to allow painting to be carried out. In general, the use of very low levels of such inhibitors does not affect the performance of subsequent paint coatings for non-immersed steelwork. The use of a moisture tolerant primer, which can be applied to wet blasted steel while it is still damp, can make the use of inhibitors unnecessary, but International Protective Coatings should be consulted for specific advice.

Where wet blasted surfaces have been allowed to corrode, they should be mechanically cleaned or preferably sweep blasted, to remove the corrosion prior to painting.

HYDROBLASTING

Hydroblasting is a technique for cleaning surfaces, which relies entirely on the energy of water striking a surface to achieve its cleaning effect. Abrasives are NOT used in hydroblasting systems. Consequently the problems caused by dust pollution and by the disposal of spent abrasives are eliminated. Two different hydroblasting operating pressures are commonly encountered.

- High pressure hydroblasting, operating at pressures between 680 bar (10,000 p.s.i.) and 1,700 bar (25,000 p.s.i.).
- Ultra high pressure hydroblasting, operating at pressures above 1700 bar (25,000 p.s.i.).

The terms hydroblasting, hydrojetting and water jetting essentially mean the same thing, with all being used to describe the same process. There can be confusion however over the difference between simple water washing and hydroblasting. To clarify the situation, International Protective Coatings have adopted the following commonly accepted definitions.

Low Pressure Water Washing:
Operates at pressures less than 68 bar (1,000 p.s.i.).

High Pressure Water Washing:
Operates at pressures between 68-680 bar (1,000-10,000 p.s.i.).

High Pressure Hydroblasting:
Operates at pressures between 680-1,700 bar (10,000-25,000 p.s.i.).

Ultra High Pressure Hydroblasting:

Operates at pressures above 1,700 bar (25,000 p.s.i.) with most machines operating in the 2,000-2,500 bar range (30,000-36,000 p.s.i.).

The International Protective Coatings Hydroblasting Standards have been prepared using ultra high pressure hydroblasting equipment. This standard however is also applicable to surfaces produced by a whole range of hydroblasting pressures, providing the equipment used is capable of cleaning to the visual standard depicted.

The steel surfaces produced by hydroblasting do NOT look the same as those produced by dry abrasive blasting, or slurry blasting. This is because water on its own cannot cut, or deform steel in the same way as abrasives. Hydroblasted surfaces therefore tend to look dull, even before they “flash rust”. In addition steel, with active corrosion pitting, shows a mottled appearance after hydroblasting. Mottling occurs when the corrosion products are washed out of the pits, leaving a bright patch, and the surrounding areas are left a dull grey, brown to black colour. This pattern is the reverse of that left by abrasive blasting, where anodic pits are often dark, due to corrosion products not being entirely removed, and the surrounding areas are bright. “Flash rusting”, i.e. light oxidation of the steel, which occurs as hydroblasted steel dries off, will quickly change this initial appearance.

When flash rusting is too heavy for coating application, it may be removed or reduced by brushing with a hard bristle brush, or by washing down with high pressure fresh water. High pressure washing, at pressures above 68 bar (1,000 p.s.i.) using either the rotational nozzles, or fan jet lances of the hydroblasting equipment itself is the preferred method. It will cause the area to re-rust, but it is possible to reduce the degree of flash rusting from heavy to light using this method. Hand wire or bristle brushing to remove heavy flash rusting may be acceptable for small areas, but will generally produce an inadequate surface. Mechanical rotary wire brushing can however produce acceptable surfaces for large areas.

When large areas are hydroblasted, flash rusting which obscures the original blast standard may occur, before an inspection can be carried out. Establishing the required standard by blasting a small test area prior to the main blast may help, providing the rest of the job is blasted to the same standard. Methods for ensuring the rest of the job is blasted to the same standard will vary from project to project.

Flash rusting can be prevented by the use of water soluble chemical corrosion inhibitors. These inhibitors may leave a crystalline layer on the steel surface as the water evaporates, which can then lead to a loss of adhesion and osmotic blistering, if coatings are applied over this type of surface. International Protective Coatings do not recommend the use of corrosion inhibitors to hold wet blasted surfaces. If inhibitors are used, they must be thoroughly washed off with fresh water before International Protective Coatings products are applied.

The temperature of steel substrates can rise during the hydroblasting process. There are two reasons for this:

a) Compression of the water to reach hydroblasting pressure will create a temperature rise in the water itself,

b) the velocity of the water striking the steel will impart energy to it as heat. This temperature rise can be substantial and may help hydroblasted surfaces dry off more quickly, with a corresponding reduction in the severity of flash rusting.

An important property of the hydroblasting process is that it can emulsify and remove oil and grease from a surface as it is blasted. However, this does not preclude the need for proper degreasing procedures as specified in SSPC-SP1, prior to hydroblasting.

Hydroblasting will not produce a surface profile, although the process can eventually erode steel and result in metal loss. The surface profile exposed after hydroblasting will have been produced by earlier surface preparation work, or by corrosion. For most coating schemes, International Protective Coatings will accept a profile in the 50 to 100 microns range.

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NON-FERROUS METAL

Aluminium

The surface should be clean, dry and grease-free (see under Steel - Degreasing). If any corrosion salts are present they should be removed by lightly abrading. Before painting, apply one thin coat of a proprietary acid etch primer to provide a key for further coats. A colour change from pale yellow to green/brown should occur. If this reaction does not take place, adhesion will be found to be poor. The surface should be scraped clean, and treated with a proprietary aluminium pretreatment solution, and the acid etch primer then re-applied.

Galvanised Steel

The surface should be clean, dry and grease free (see under Steel - Degreasing). Degreasing of most galvanised surfaces requires some effort to obtain a clean surface. Any white zinc corrosion products should be removed by high pressure fresh water washing, or fresh water washing with scrubbing. When using the preferred method of surface preparation, i.e. sweep blasting, it is still advisable to fresh water wash to remove soluble zinc salts. Many coatings based on non-saponifiable polymers can be applied directly to galvanised surfaces prepared in this way.

When sweep blasting is not possible, then an acid etch solution or etch primer should be used to passivate the surface and provide a key for further paint coatings. Details of coatings which can be applied to sweep blasted galvanised steel and of suitable etch solutions and primers can be obtained from International Protective Coatings.

When steel has been treated with a passivating treatment immediately after galvanising, then this must either be allowed to weather off over a period of several months exterior exposure or be abraded before application of a coating. In general etch treatments have no effect on fresh materials of this type.

Other Non-Ferrous Metals

The surface should be clean, dry and grease free (see under Steel - Degreasing). Any corrosion salts should be removed by light abrasion and water washing. The cleaned surface should then be abraded or very lightly abrasive blasted using low pressure and non-metallic abrasive, and primed with a coat of etch primer prior to painting. For lead, if the surface is thoroughly abraded, the etch primer may be omitted.

CONCRETE AND MASONRY SURFACES

The surface should be clean, dry and free from oil, grease and other contaminants such as forming lubricants and curing components which would affect adhesion of a paint coating. The moisture content of the concrete or masonry should be less than 6%, measured using a Protimeter Surveymaster or similar. As a rule of thumb, concrete less than 28 days old, in a temperate climate, is unlikely to have dried our sufficiently.

Note:- Painting over surfaces, which have not sufficiently dried out, will result in blistering and flaking of the paint coating as the trapped moisture gradually escapes.

Laitence and loose surface powder formed on new concrete must be removed. The alkalinity and porosity of the surface must also be considered when painting concrete or masonry. The most preferable surface treatment for concrete is sweep blasting. Wire brushing also provides a suitable surface for painting, but requires more effort. Alternatively, a proprietary acid etch treatment followed by thorough water washing and drying may be used. Any cracks should be cut out and filled with a suitable filler prior to painting. Blow holes may also require filling - consult International Protective Coatings for specific advice.

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Concrete Floors

Preparation of concrete floors is achieved by blasting, scarifying, grinding or by hand. Final choice will be based on the condition of the existing surface, floor area, access for preparation equipment and the coating to be applied.

1. **Blasting -** The concrete should be blasted using a recoverable abrasive blasting unit.

2. **Scarifying -** Scarifyers are machines which include fast-rotating hardened flails, which remove old coatings and roughen the concrete substrate. Scarifyers are generally used for areas less than 250m^2 , for larger areas it is normal practice to blast.

3. **Grinding -** The floor should be thoroughly prepared using a mechanical grinder to remove laitence, fines and any surface contamination.

The final process for all methods of preparation is thorough vacuum cleaning to remove all residual dust.

SAFETY CONSIDERATIONS

Always carefully read and completely follow the safety procedures and instructions recommended by manufacturers of surface preparation devices, application equipment, media or products and the job site safety measures.

Always carefully read and follow the paint manufacturer's safety procedures and instructions concerning paint products.

These are general statements to alert you to the importance of specific warnings and instructions on individual products. These statements are not intended to be specific warnings or advice.