3. CORROSION PRODUCTS : All cleaning methods as mentioned above should be extended to cater for the more difficult removal of rust.

4. SOLUBLE SALTS : These are commonly encountered on steel that has been allowed to rust in a polluted atmosphere. Removal of salts formed in pits is difficult but essential if premature failure is to be avoided. The use of wet blasting is advised. Careful control by visual and chemical means is advocated.

Blast cleaning is strongly recommended in all cases where high quality long life expectancy systems are called for.

5. PHOSPHATING : Chemical conversion treatment is common in OEM industries where generally CRCA/ HRCA sheets of lower thickness are used. Chemical conversion treatment is, commonly known as Phosphating, generally done with dipping or spraying.

Dip phosphating is the most commonly adopted method in OEM industry. Spray phosphating is preferred mostly where space constraint is observed. Spray phosphating is generally coarser in structure & hence less preferred, while dip phosphating has more controlled particle size & structure.

Generally chemical conversion is done with metal ions like Zinc modified with Calcium or Zinc with Nickel & Manganese. The tricationic coating with Zinc, Nickel & Manganese is done in Automobile Industry, while treatment with Iron & Calcium modified Zinc is preferred in other OEM Industries.

Phosphating includes the stages of:

1. Cleaning of metal degreasing,
2. Removal of rust derusting (in severe cases Acid pickling)
3. Surface activation,
4. Phosphating,
5. Passivation.

The actual work stages may vary from 3 to 10 depending upon many factors. The no. of tanks generally employed are 7 & hence known as 7-tank process. The phosphating improves the adhesion & corrosion resistance properties of the paint system. There are variety phosphating chemicals available in the market. Chemical which gives compact coating from a reputed suppliers are to be preferred as the process required lots of technical support for bath maintenance.

Notes: The 3 in 1 solution / cold phosphating without rinsing generally gives very poor performance as they leave left over of acid on the surface which interface in corrosion resistance subsequently and shall be avoided.

B. For Non-ferrous Metals

The following recommendations for non-ferrous metals, including galvanised steel, will provide the proper surfaces on which to apply coating.

Aluminium : Solvent was to remove organic matter. For some systems, either a chromates or phosphate pre-treatment is recommended. For other systems, they may be applied directly to aluminium if an anchor pattern is provided by brush-blasting. Application of an etch primer, viz. GP PRIME 401 or GP PRIME 203 is recommended before painting.

Note : Blasting is never used on sheet aluminium because of the warping may occur.

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Galvanised Metal : New galvanised metal often comes from the mill or supplier with a light, invisible coating of Cosmo line or other material to keep it bright. This must be removed by solvent washing.

Weatherized galvanised metal may have remnants of the brightener remaining or a light skiff of zinc oxidation products, depending on the length of exposure, solvent washing is effective in removing these potential bond-breakers.

Application of an etch primer, viz. GP PRIME 401 / GP PRIME 203 is recommended before painting.

Stainless Steel and Other Alloys : Solvent wash to remove oil and grease. Brush blasting to provide a suitable anchor pattern is most often recommended depending on the mill finish. Bright, polished stainless steel and other polished metals can be a problem unless an anchor pattern is provided.

C. Concrete and Mansonry

Failure of coating on concrete and masonry is often caused not so much from a failure of adequate surface preparation as from a construction configuration which: allows moisture to wick into the concrete from behind, above or below, and become trapped behind the coated surface. Unless vapour barriers or stops are built-in where concrete is below or on grade or where concrete floors are used as the base for laid-up block or bricks, etc., coating performance will be jeopardized.

Expansion joints are present to accommodate the movement of concrete or masonry structures and should not be coated over as part of the single continuous film which covers the adjacent areas.

Methods : The most efficient method of preparing concrete for coating is by sand blasting. This eliminates form release agents, removes surface laitance, reveals air pockets and creates an anchor pattern.

Where sand blasting is not possible or practical, these general recommendations should be followed :

1. Remove dust, dirt. oil, grease and form release agents. This can usually be accomplished by scrubbing with a strong alkaline detergent.
2. Check for voids which will often be only small openings in the surface with larger voids beneath. Large voids should be filled with latex concrete or cement grout (2 parts cement to 1 part fine sand). Voids left in the surface may result in bridging by the coating and subsequent failure when the trapped air expands.
3. Etch the surface with a solution of 1 part commercial hydrochloric acid in 2 parts water. Allow the acid solution to "work" for 5-10 minutes, then thoroughly flush the surface with water and allow to dry thoroughly. This will neutralise laitance and efflorescence and provide a slight anchor pattern. This treatment is really only practical for floors or horizontal surfaces.
4. Vacuum cleaning of the surface is recommended before painting.

Where sand blasting is not possible, alternative mechanical means are scarifier, power grinder with vacuum attachment are employed.

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SURFACE PREPARATION

The Need

There are two main factors which govern the performance of a protective paint system, mainly the nature of the paint coating and the degree of cleanliness of the surface to which it is applied.

THE OPTIMUM 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 PRE-TREATMENT IS INCORRECT OR INCOMPLETE.

Common Surface Contaminants

1. Oil & Grease -Deposited from the working environment.
2. Millscale -Oxide formation from the hot rolling process at the steel mill.
3. Corrosion products -Rust and scale formed on unprotected steel.
4. Soluble salts -Deposited from the atmosphere.
5. Laitance -On concrete.
6. Zinc Salts -On galvanised surface and weathered Zinc Rich Epoxy/Zinc Silicate Coating. The removal of such contaminants is essential for optimum performance and Mechanical means like emery scuff or wire brush the surface followed by thorough washing with fresh water.

The following notes cover methods of removal of above contaminants.

A. For 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. Indian Standard-IS: 1477 (Part I & II) 1963.
2. Steel Structures Painting Council (SSPC), Pittsburgh, PA, USA.
3. British Standards Code of Practice BS 5493 and DIN 55928 for Protective Coating of Iron and Steel structures against Corrosion.
4. ISO 8501-1:1988 (Swedish Standard SIS 05 5900) - Pictorial Surface Preparation Standards for Painting Steel Structures). GP refer ISO 8501-1:1988standard. Shipbuilding Research Association of Japan-Standard for the preparation of Steel Surfaces Prior to Painting ("SPSS" Standard).

1. OIL & GREASE

1. Degreasing : All Oil, Grease, Drilling and Cutting Compounds and other Surface Contaminants if present even in trace quantities this may impair the adhesion of protective paint systems and lead to premature failure. Removal by solvent swabbing is common; however, it is essential that the deposits are removed and not simply spread over the surface. A number of washes using clean solvent and swabs is essential. GP's Thinner may be used as per recommendation given in individual Data Sheet.

Degreasing procedures are described in SSPC-SP1

2. MILLSCALE : This layer of Oxides although initially intact readily embrittles and flakes off bringing with it the paint system.

Numerous methods of scale removal have been used.

1. Natural Weathering : This is an unreliable practice as the surface will remain contaminated with soluble salts and corrosion products.

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2. Hand Tool Cleaning : The degree of cleanliness achieved is largely dependent upon the amount of weathering to which the steel has been subjected, and the efforts of the operators who have difficulty maintaining a constant satisfactory standard.

It is impossible to remove all rust and millscale by this method. Generally this method would be adopted for the following :

A. Maintenance Painting.
B. Easily Accessible Steelwork in Rural Areas.
C. Steelwork inside Building where conditions are Non-corrosive.
D. Steelwork which is to be encased in brickwork, concrete, etc.
E. Internal Surfaces of enclosed spaces that require Painting.

Methods for Hand Tool Cleaning are described in SSPC -SP 2 and should be to Swedish Standard St.2 -B, C or D.

3. Power Tool Cleaning : Although impact tools such as chipping hammers and needle guns are reasonably effective in removing rust and scale the time and effort required is excessive.

Power rotary wire brushes and grinding tools wear away the unwanted surface layer. This method tends to burnish the surface especially where firmly bonded scale exists. The burnished surface effectively reduces the adhesion properties of the primer.

Other unfavorable factors are excessive noise levels and dust hazard. Generally this method would be adopted on maintenance painting where areas require remedial treatment.

Methods are described in IS: 1477 (Part-I)-1963, in SSPC -SP 3 and in ISO 8501-1: 1988 should be to Swedish Standard St 3 -B, C or D.

4. Flame Cleaning : In flame cleaning method, a high temperature oxyacetylene flame is passed over the surface. Scale and rust are dislodged partly by differential expansion of the steel and scale and partly by evolution on steam from moisture within the rust. Scraping and wire brushing is necessary to remove the burnt residues. The methods for flame cleaning are outlined in IS : 1477 (Part-I)-1963 / ISO 8501-1: 1988.

The main disadvantages of this method are :

A. Fire and Health Hazard.
B. Possible damage to adjacent areas.
C. Steel must be atleast 16 gauge thick to avoid buckling.
D. Steel temperature must not exceed 300° C.
E. Use prohibited on high strength friction grip joints and adjacent areas.

5. Acid Pickling : Millscale and rust can be removed by immersion in acid solution such as sulphuric or hydrochloric.

The pickling carries out its function in two different ways. First, the acid serves to dissolve both scale and rust. Secondly, as the acid creeps into the breaks of the millscale a reaction between the innermost layers of millscale and the acid evolves hydrogen gas.

This gassing results in the millscale popping off. Following a hot water rinse the steel is often depend in a bath containing a solution of phosphoric acid. The phosphoric acid reacts with the steel to form a thin film of iron phosphate which acts as a rust inhibitor.

A coat of priming paint should be applied as quickly as possible after drying. The main disadvantages to this method are:

A. A wet process with effluent and fume control requirements.
B. Unsuitable substrate for metal spray and many two pack systems.
C. A workshop operation with work limited to size of baths. Generally, pickling is done by specialist firms.
D. Process not suitable for structural steel or large objects.

6. Abrasive Blast Cleaning : Prior to blast cleaning any obvious surface defects in the steel such as lamination, shelling, weld spatter, etc. should be removed by chipping or grinding.

Any defects unobserved prior to blast cleaning and priming should be treated at the priming stage and touched up as necessary. Where steel has been allowed to rust extensively, longer times for blast cleaning may be required.

It is therefore advisable to blast clean prior to rusting whenever practicable.

2.6.1 : ABRASIVE BLAST CLEANING describes all methods used to project an abrasive onto the object e.g. air blasting, centrifugal blasting, or water/sand blasting. During the course of development this type of cleaning has been given several different names, e.g. sand blasting, shot blasting and grit blasting, depending upon the abrasive used. For details of sand blasting procedure refer to IS: 1477 (Part-11)-1963. To avoid any confusion it is recommended to use the term 'Blast Cleaning'.

ABRASIVE BLAST CLEANING IS THE PREFERRED METHOD OF PREPARING STEEL AS RUST, MILLSCALE AND OLD PAINT COATINGS ARE EFFECTIVELY REMOVED.

TABLE OF INTERNATIONAL STANDARDS OF ABRASIVE BLAST CLEANING

Description	White Metal	Near -White Metal	Commercial Blast	Brush-off Blast
Swedish Standard SIS 05-5900:1967	Sa3	Sa 2½	Sa2	Sa1
British Standard BS 4232: 1967	First Quality	Second Quality	Third Quality	--
Steel Structures Painting Council (USA)	SSPC-SP 5-63	SSPC-SP 10-63T	SSPC-SP 6-63	SSPC-SP 7-63
National Association of Corrosion Engineers (USA)	NACE No. 1	NACE No.2	NACE No. 3	NACE No. 4
Shipbuilding Research Association of Japan SPSS	JASh3 JASd3	JASh2 JASd2	JASh 1 JASd1	-
Canadian Government CGSB	31 GP404 Type 1	-	31 GP404 Type 2	31 GP404 Type 3

The Swedish Standard, as it was usually called, was first to employ pictorial representation as of the specified cleaning degrees.

It is now superseded by INTERNATIONAL STANDARD ISO 8501-1: 1988. Yet with the same photos as used by the SIS standards plus additionally four photos (flame cleaning) from the German Standard DIN 55928, part 4, Supplement 4.

The British Standard uses drawings to indicate the (Second and Third quality) finishers, whereas the American and the German Standards use the same photos as ISO 8501-1-: 1988. Yet, DIN 55928 includes photos of secondary surface preparation too.

Except for BS 4232 they all take into account the state of the raw steel surface before cleaning and grades the result accordingly.

A. Steel surface largely covered with adherent millscale but little, if any, rust.
B. Steel surface which has begun to rust and from which the millscale has begun to flake.
C. Steel surface on which the millscale has rusted away or from which it can be scraped, but with slight pitting visible under normal vision.
D. Steel surface on which the millscale has rusted away and on which general pitting is visible under normal vision.

The blast cleaning provides a roughened surface with the surface amplitude or profile {peak to trough) being reasonably controlled by the amount of air pressure and the type and size of abrasive used. It is important that the surface profile be considered in relation to the dry film thickness (dft) and type of primer involved especially if the primed steel is to be subjected to exterior locations. 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.-0.2mm grain size	-	75/100 microns (3-4 mils)
Iron grit No. G16	12	200 microns {8.0 mils)

2.6.2 : VACUUM BLASTING :

Ideal for small repair areas, welds, etc. The abrasive is collected for re-use by shrouding the blasting nozzle with a vacuum hood.

The mixed abrasive and debris pass through a separating device before the filtered abrasive is returned to the blasting circuit.

2.6.3 : WET ABRASIVE BLASTING :

The abrasive is carried to the work surface in a stream of water. It is necessary to use non-metallic abrasives.

Corrosion inhibitors may be added to the water to delay re-rusting of the steel. The amount and type of inhibitor additions must be strictly monitored to ensure that the adhesive properties of the paint coating are not impaired. Too much inhibitor may have the same effect as leaving corrosion products on the surface thus reducing the adhesion of the paint system to the surface.

The prime advantages of this method are :

a. The hazards of dust and associated health problems are largely overcome.
b. The changes of fire hazards are eliminated; enabling its use inside working installations.

Fresh water hosing/cleaning (FWH/FWC) : Up to 60-bar/860 psi
High pressure fresh water hosing (HPFWH) : 60-200 bar/860-2900 psi
High pressure fresh water cleaning (HPFWC) : 200-350 bar/2900-5000 psi
High pressure fresh water blasting (HPFWB) : 350-1000 bar/5000-14500 psi
Hydro blast (HB)/fresh water jetting (FWJ) : Above 1000 bar/14500 psi