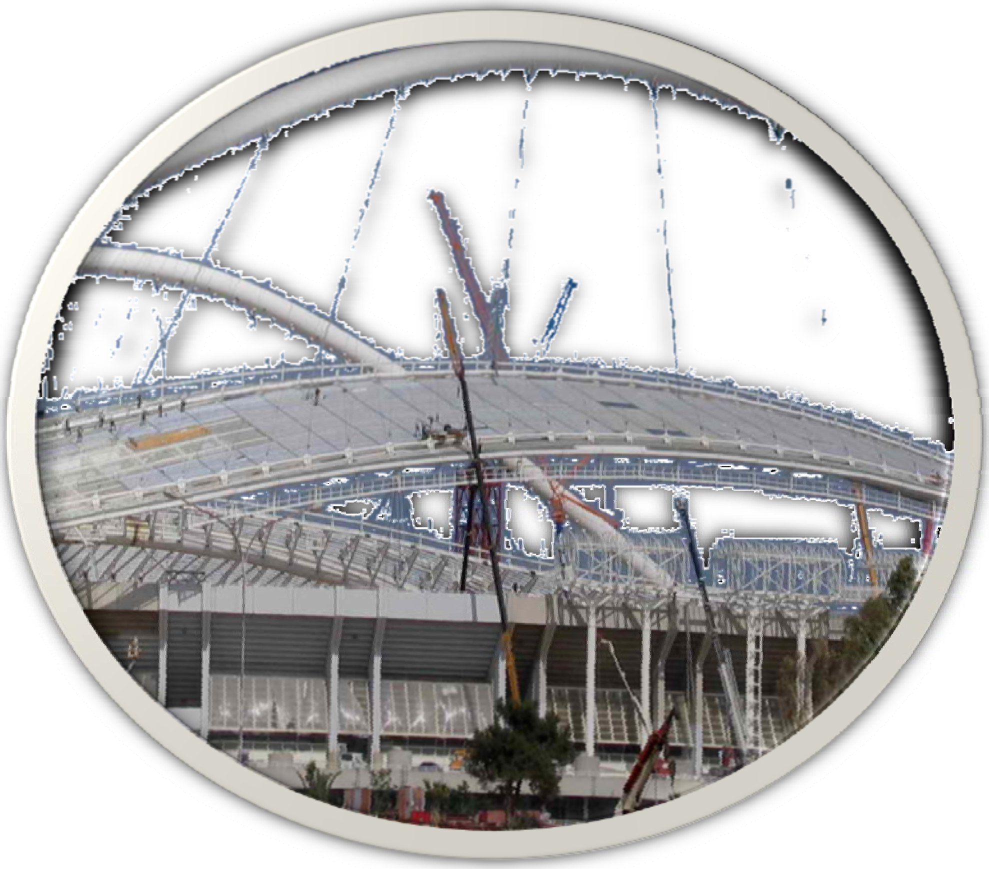
*"The performance of any paint coating is directly dependent upon the correct and thorough preparation of the surface prior to coating.*
*The most expensive and technologically advanced coating system will fail if the surface preparation is incorrect or incomplete"*

# Paint Guide – Surface Preparation



*"In the following pages we have prepared for you a brief presentation about the considerations that have to be taken, prior the use of our coating systems, in terms of surface preparation , international practices and related advices. We hope that this guide could be a valuable tool towards to a successful application and the desired performance"*

*Abolin Co*
*October 2011*

**Important Note**

*The information given in this Guide is for general guidance only and is not guaranteed as being wholly accurate or complete. Unless otherwise agreed in writing, the content of this Guide is for internal communication reasons only and therefore it is addressed to the needs of the above scope only. Any other use must have the written agreement by Abolin Co.*

# Surface Preparation

## 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).

## 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.

## 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 Sa2 ½ (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 Sa2 ½ (ISO 8501-1:1988) or SSPC-SP10, however, when products are recommended for general atmospheric exposure the blasting standard required will be Sa2 ½ (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.

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 Abolin Co. 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, Abolin Co 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 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. Abolin Co. 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 Abolin Co. 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, Abolin Co. will accept a profile in the 50 to 100 microns range.

### 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. 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 aluminum 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 Abolin Co.

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.

Laitance 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 suitable filler prior to painting.

The following guide will help assure maximum performance of the coating system and satisfactory coating adhesion to concrete:

1. Remove all surface contamination (ref. ASTM D4258).

2. Wet surface with clean water.
3. Apply a 10 - 15% Muriatic Acid or 50% Phosphoric Acid solution at the rate of one gallon per 75 square feet.
4. Scrub with a stiff brush.
5. Allow sufficient time for scrubbing until bubbling stops.
6. If no bubbling occurs, the surface is contaminated with grease, oil, or a concrete treatment which is interfering with proper etching. Remove the contamination with a suitable cleaner (ref. ASTM D4258, or Method "D" below) and then etch the surface.
7. Rinse the surface two or three times. Remove the acid/water mixture after each rinse.
8. Surface should have a texture similar to medium grit sandpaper.
9. It may be necessary to repeat this step several times if a suitable texture is not achieved with one etching. Bring the pH (ref. ASTM D4262) of the surface to neutral with a 3% solution of trisodium phosphate or similar alkali cleaner and flush with clean water to achieve a sound, clean surface. Allow surface to dry and check for moisture (ref. ASTM D4263).

### 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 laitance, 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 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.

# SURFACE PREPARATION STANDARDS

**The old SWEDISH STANDARDS INSTITUTION:**

Surface Preparations Standards for Painting Steel Surface (SIS 055900 - 1967) has gained prominence and acceptance across the frontiers. So much so that it has served as a model for and has even been adopted direct as national standard in other countries. Its cleaning degrees Sa 2, Sa 2½, etc. being practically universally recognized, they are referred to throughout this book in recommendations for cleaning of steel.

The Swedish Standard, as it was usually called, was first to employ pictorial representations of the specified cleaning degrees. It is now superseded by INTERNATIONAL STANDARD ISO 8501-1:2007. Yet with the same photos as used by the SIS standard plus additionally four photos (flame cleaning) from the former German standard DIN 55928, Part 4, Supplement 4.

Other prominent standards, notably STEEL STRUCTURES PAINTING COUNCIL (U.S.A.): Surface Preparation Specifications (SSPC-SP 2, 3, 5, 6, 7, and 10) BRITISH STANDARDS INSTITUTION; Surface Finish of Blast-cleaned steel for Painting: (BS 4232 but now superseded by BS 7079) and **INTERNATIONAL STANDARDIZATION ORGANIZATION ISO 12944, Parts 1 through 8:** Corrosion Protection of Steel Structures by Protective Paint Systems, do also concern with the equipment, materials and procedures used to achieve the specified finish.

The British Standard BS 4232 used drawings to indicate the (Second and Third quality) finishes, whereas the American uses the same photos as ISO 8501-1:2007. ISO 12944 refers to ISO 8501-1:2007, but includes also descriptions for secondary surface preparation with reference to ISO 8501-2:1994. 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 mill scale but little, if any, rust.

**B:** Steel surface which has begun to rust and from which the mill scale has begun to flake.

**C:** Steel surface on which the mill scale has rusted away or from which it can be scraped, but with slight pitting visible under normal vision.

**D:** Steel surface on which the mill scale has rusted away and on which general pitting is visible under normal vision.

A surface preparation method using high pressure water for cleaning is getting more common. The best definition of terms and surface preparation standards are presented by ISO 8501-4:2006. For comparison of the standards see the following pages.

**ISO 8501-1:2007**

Designation Description

**Sa 3 Blast-cleaning to visually clean steel.**

When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and shall be free from mill scale, rust, paint coatings and foreign matter. It shall have a uniform metallic colour. See photographs A Sa 3, B Sa 3, C Sa 3 and D Sa 3.

**Sa 2½ Very thorough blast-cleaning.**

When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from mill scale, rust, paint coatings and foreign matter. Any remaining traces of contamination shall show only as slight stains in the form of spots or stripes. See photographs A Sa 2½, B Sa 2½, C Sa 2½ and D Sa 2½.

**Sa 2 Thorough blast-cleaning.**

When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from most of the mill scale, rust, paint coatings and foreign matter. Any residual contamination shall be firmly adhering (see note 2 below). See photographs B Sa 2, C Sa 2 and D Sa 2.

**Sa 1 Light blast-cleaning.**

When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from poorly adhering mill scale, rust, paint coatings and foreign matter (see note 2). See photographs B Sa 1, C Sa 1 and D Sa 1.

**Notes:**

1. The term "foreign matter" may include water-soluble salts and welding residues. These contaminants cannot always be completely removed from the surface by dry blast-cleaning, hand and power tool cleaning or flame cleaning; wet blast cleaning or hydro-jetting may be necessary.
2. Mill scale, rust or a paint coating is considered to be poorly adhering if it can be removed by lifting with a blunt putty knife.

**St 3 Very thorough hand and power tool cleaning.**

As for St 2, but the surface shall be treated much more thoroughly to give a metallic sheen arising from the metallic substrate. See photographs B St 3, C St 3 and D St 3.

**St 2 Thorough hand and power tool cleaning.**

When viewed without magnification, the surfaces shall be free from visible oil, grease and dirt, and from poorly adhering mill scale, rust, paint coatings and foreign matter (see note 2). See photographs B St 2, C St 2 and D St 2.

**Notes:**

1. For descriptions of surface preparation methods by hand and power tool cleaning, including treatment prior to, and after, the hand and power tool cleaning procedure, see ISO 8504-3.
2. Preparation grade St 1 is not included as it would correspond to a surface unsuitable for painting.

**BS 7079-1990 Replaces BS 4232-1967. BS 7079-1990 is identical to ISO 8501-1: 2007**.

**SSPC**

Designation Description

**SSPC-SP-5**

**1.1** A white Metal Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter.

**1.2** ACCEPTABLE VARIATIONS IN APPEARANCE THAT DO NOT AFFECT SURFACE CLEANLINESS as defined in Section 1.1 include variations caused by type of steel, original surface condition, thickness of the steel, weld metal, mill or fabrication marks, heat treating, heat affected zones, blasting abrasive, and differences in the blast pattern.

**1.3** When painting is specified, the surface shall be roughened to a degree suitable for the specified paint system.

**1.4** Immediately prior to paint application the surface shall comply with the degree of cleaning as specified herein.

**1.5** SSPC-Vis 1-89 or other visual standards of surface preparation may be specified to supplement the written definition.

**SSPC-SP-10**

**2.1** A Near-White Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining as noted in

**Section 2.2**.

**2.2** Staining shall be limited to no more than 5 per cent of each square inch of surface area and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied paint.

**2.3** ACCEPTABLE VARIATIONS IN APPEARANCE THAT DO NOT AFFECT SURFACE CLEANLINESS as defined in sections 2.1 and 2.2 include variations caused by type of steel, weld metal, mill or fabrication marks, heat treating, heat affected zones, blasting abrasives, and differences in the blast pattern.

**2.4** When painting is specified, the surface shall be roughened to a degree suitable for the specified paint system.

**2.5** Immediately prior to paint application, the surface shall comply with the degree of cleaning as specified herein.

**2.6** SSPC-Vis 1-89 or other visual standards of surface preparation may be specified to supplement the written definition.

**SSPC-SP-6**

**3.1** A Commercial Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining, as noted in

**Section 3.2.**

**3.2** Staining shall be limited to no more than 33 per cent of each square inch of surface area and may consist of light shadows, slight streaks, or minor discolourations caused by stains of rust, stains of mill scale, or stains of previously applied paint. Slight residues of rust and paint may also be left in the bottoms of pits if the original surface is pitted.

**3.3** ACCEPTABLE VARIATIONS IN APPEARANCE THAT DO NOT AFFECT SURFACE CLEANLINESS as defined in Sections 3.1 and 3.2 include variations caused by type of steel, original surface condition, thickness of the steel, weld metal, mill or fabrication marks, heat treating, heat affected zones, blasting abrasive, and differences in the blast pattern.

**3.4** When painting is specified, the surface shall be roughened to a degree suitable for the specified paint system.

**3.5** Immediately prior to paint application, the surface shall comply with the degree of cleaning as specified herein.

**3.6** SSPC-Vis 1-89 or other visual standards of surface preparation may be specified to supplement the written definition.

**SSPC-SP-7**

**4.1** A Brush-Off Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose paint. Tightly adherent mill scale, rust, and paint may remain on the surface. Mill scale, rust, and paint are considered tightly adherent if they cannot be removed by lifting with a dull putty knife.

**4.2** The entire surface shall be subjected to the abrasive blast. The remaining mill scale, rust, or paint shall be tight.

**4.3** When painting is specified, the surface shall be roughened to a degree suitable for the specified paint system.

**4.4** Immediately prior to paint application, the surface shall comply with the degree of cleaning as specified herein.

**4.5** SSPC-Vis 1-89 or other visual standards of surface preparation may be specified to supplement the written definition.

**SSPC-SP-2**

**5.1** Hand tool cleaning is a method of preparing steel surfaces by the use of non-power hand tools.
**5.2** 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.
**5.3** SSPC-Vis 1-89 or other visual standards of surface preparation agreed upon by the contracting parties may be used to further define the surface.

**ISO 12944-4** is not quoted (translated) but is fully in line with ISO 8501-1:2007 (except or the extra standards as mentioned on page 10). Comparing the standards, no doubt that Sa 3 and SSPC-SP-5 are identical in their demands to surface cleanliness. Also Sa 2½ and SSPC-SP-10 seem identical. Concerning Sa 2 and SSPC-SP-6 these differ slightly, SSPC-SP-6 expressing more demands to quality. SSPC-SP-6 requires remnants being stains only. Sa 2 states "residual contamination shall be firmly adhering". Note: For SSPC the written specification takes preference - for ISO 8501-1:2007, the photos.

**ISO 8504-1:2006**

Surface preparation and cleaning of steel and other hard materials by high and ultrahigh pressure water jetting prior to paint application. Water jetting is a relatively new method of surface preparation. The standard deals with the removal of visible and invisible contamination. After cleaning the surface will still be wet and flash rusting may occur on cleaned steel during the drying period. Additional definitions of flash rust degrees are therefore described below.
Maintenance being the main area of use, any old coating remaining after water jetting must be well adhering, intact and roughened by the treatment as well as compatible with the new coating system to be applied. As a general rule, coatings which are later to be exposed to severe mechanical and/or chemical exposures, like eg specially wear and impact resistant coatings and chemically resistant tank coatings, should not be applied to water jetted surfaces. Neither should coatings for which protection relies upon metallic contact to the steel substrate, such as zinc rich primers be applied to water jetted surfaces.

**Description of the surface appearances after cleaning:**

**Light high-pressure water jetting**

When viewed without magnification, the surface shall be free from visible oil and grease, loose or defective paint, loose rust and other foreign matter. Any residual contamination shall be randomly dispersed and firmly adherent.

**Thorough high-pressure water jetting**

When viewed without magnification, the surface shall be free from visible oil, grease and dirt and most of the rust, previous paint coatings and other foreign matter. Any residual contamination shall be randomly dispersed and can consist of firmly adherent coatings, firmly adherent foreign matter and stains of previously existent rust.

**Very thorough high-pressure water jetting**

When viewed without magnification, the surface shall be free from all visible rust, oil, grease, dirt, previous paint coatings and, except for slight traces, all other foreign matter. Discoloration of the surface can be present where the original coating was not intact. The grey or brown/black discoloration observed on pitted and corroded steel cannot be removed by further water jetting.

**Description of the surface appearance for three flash rust grades:**

**Light flash rust**

A surface which, when viewed without magnification, exhibits small quantities of a yellow/brown rust layer through which the steel substrate can be seen. The rust (seen as a discoloration) can be evenly distributed or present in patches, but it will be tightly adherent and not easily removed by gentle wiping with a cloth.

**Medium flash rust**

A surface which, when viewed without magnification, exhibits a layer of yellow/brown rust that obscures the original steel surface. The rust can be evenly distributed or present in patches, but it will be reasonably well adherent and it will lightly mark a cloth that is gently wiped over the surface.

**Heavy flash rust**

A surface which, when viewed without magnification, exhibits a layer of red-yellow/brown rust that obscures the original steel surface and is loosely adherent. The rust layer can be evenly distributed or present in patches and it will readily mark a cloth that is gently wiped over the surface.

**For further details, please refer to ISO 8501-4:2006.**

# GLOSSARY

**in reference to Abolin Co Technical Data Sheets**

**Description:** A short description of the product with emphasis on generic type, pigmentation, principal properties, and certain limitations.

**Recommended use:** The purpose(s) for which the product is designed or particularly well suited. The product may be specified for other uses in tailor-made paint systems for specific purposes.

**Service temperature:** Indicates the maximum temperature that will have no immediate detrimental effect on the paint. A service temperature constantly near the maximum will result in a shorter lifetime of the specified paint system compared to the lifetime anticipated when operating at normal temperatures. If service temperatures are often fluctuating between normal temperatures and near maximum temperatures this will result in an additional decrease in the anticipated lifetime of the paint system ("accelerated ageing"). Most paints will change appearance when exposed to high temperatures, either by a change in colour and/or by loss of gloss.

In addition most paints will become soft at high temperatures and show higher sensitivity to mechanical or chemical actions. Exposure to warm liquids, water included, will normally only be recommended for dedicated paint systems. At high temperatures, wet service will have a more pronounced influence on lifetime compared to dry service. When a paint system is exposed to fluctuations of temperatures wet service conditions will induce more stress to the coating system than dry service at same temperatures. Furthermore it is of importance whether the liquid has a higher temperature than the coated steel. A “cold wall” effect will increase the risk of blistering and thus put further limitations to the temperature resistance. Most paint systems do only tolerate a very low negative gradient of temperature under wet/immersed service conditions.

**Finish:** The appearance of the paint film after drying under optimum conditions in laboratory, given as high gloss (>90), glossy (60-90), semi-gloss (30-60), semi-flat (15-30), or flat (<15). All figures are in gloss units and according to ISO 2813:1994(E) (specular gloss, 60 degree geometry). The actual appearance will depend on the conditions during application and drying/curing. The finish indicated in the product data sheet is according to optimal conditions (ie application and measurements under standardised laboratory conditions).

**Colours/shade:** Certain physical constants may vary from one colour to another.

**Volume solids:** The Volume Solids (VS) figure expresses in percentage the ratio: Dry film thickness/Wet film thickness The stated figure has been determined as the ratio between dry and wet film thickness of the coating applied in the indicated thickness under laboratory conditions, where no paint loss has been encountered. For selected paints not drying too fast an alternative airless spray procedure is: A paint is applied by airless spray in the indicated thickness to a smooth, degreased steel panel. Application and drying/curing conditions of the paint are (approx) 23°C/73°F and 50% RH. A number of wet film thickness measurements are taken immediately after application followed by a similar number of dry film thickness measurements 7 days (approx 23°C/73°F, 50% RH) after application. Volume solids are usually slightly higher than the theoretical value, which is found by a calculation based on the paint composition taking specific gravity and solid content of each individual raw material into consideration. Volume solids take into account that small amounts of solvents are usually retained, and that air may be entrapped in the dry paint film either in the form of vacuoles or as interstices in zinc silicates. Volume solids are in better agreement with practical measurements of dry film thickness than the theoretical value.

**Consumption factor**: The practical consumption is estimated by multiplying the theoretical consumption with a relevant Consumption Factor (CF).

The Consumption Factor depends on a number of external conditions and cannot be stated in the product data sheet as the variation is too great to be represented by one single figure.

The variation in the Consumption Factor is largely attributed to the following:

**1) Waviness of paint film:**

In order to ensure the specified minimum film thickness, a manually applied paint film will unavoidably a) show some waviness of the surface and b) a thickness distribution with an average value somewhat higher than the specified dry film thickness in order to fulfil eg an 80:20 rule. This leads to a higher consumption than theoretically calculated.

**2) Complexity and size/shape of the surface to be calculated**:

Complex, odd-shaped and small-sized surfaces are virtually impossible to paint without overspray and will therefore lead to higher consumption than theoretically calculated from the area square in question.

**3) Surface roughness of the substrate:**

Surface roughness of the substrate gives a "dead volume" to be filled up or in the case of shopprimers a "surface area ratio" greater than one and will therefore cause a higher consumption than theoretically calculated for a smooth substrate.

**4) Physical losses**:

Factors such as residues in cans, pumps and hoses, discarded paint due to exceeded pot life, wind loss, etc. will all contribute to a higher consumption.

The Practical spreading rate thus varies with method of application, skill of the painter, shape of the object to be painted, texture of the substrate, film thickness applied, and working conditions. In any case it is not beneficial to stretch the paint as much as possible, but rather to try to obtain the specified thickness of the applied paint on the entire area.

**Flash point:** The lowest temperature at which a liquid liberates sufficient vapour to form a mixture with the air near its surface which, if ignited, will make a small flash, but not catch fire. For two-component products flash points are normally given for the mixed products. The figures are given as guidance with a view to local regulations for precautions against fire during use.

**Adding THINNER to a paint may change the flash point of the diluted material.**

**Specific gravity:** The weight in kilogramme per litre at 25°C/77°F.

For two-component products the specific gravity is given for the mixed product. The specific gravity may in practice vary in an interval of a few percent compared to the theoretical value indicated in the product data sheet.

**Dry to touch:** Drying time in the product data sheet is "dry to touch" unless otherwise indicated. For shopprimers a more relevant figure for "dry to handle" is given. Drying times refer to a temperature of 20°C/68°F, 60-70% relative humidity, with adequate ventilation.

**"Dry to handle":** The paint surface is sufficiently hardened to be handled with care without coming off/being damaged.

The drying process until "dry to touch" is - for solvent (or water) containing paints – first and foremost dependent on ventilation. Furthermore it depends on the temperature and on the film thickness of each coat applied. All surfaces should be ventilated. It should be noted that water-borne paints have higher requirements to ventilation than do solvent-borne paints. In the case of physically drying paints, drying time is also influenced by the number of coats, the total film thickness of the system and the film thickness per coat. As a rough rule of thumb, twice the film thickness of a given single coat will require approx 4 times the drying time with the same amount of ventilation. This goes for both solvent and water-borne paints. It should be stressed that when apply applying more coats, entrapped solvents may result in a softer film than if only one coat is applied. This is especially relevant in the case of physically drying paints.

Also temperature has much influence on the drying/curing time. A temperature drop of 10°C/18°F will roughly require twice the drying time for physically drying paints.

**Fully cured:** The curing time is given for two-component products at a (steel) temperature of 20°C/68°F and provided adequate ventilation. The curing is accelerated at higher temperatures and retarded at lower temperatures. For some products the curing times at different temperatures are given as a table in the product data sheet/in the

**Application Instructions**. For products where the curing time is given at 20°C/68°F only, the following rough rule of thumb can be utilised: The curing time is roughly halved at an increase in temperature of 10°C/18°F, and doubled at a decrease in temperature of 10°C/18°F.

Curing will stop almost completely below the temperature stated under application conditions as the lowest temperature at which the paint should be applied.

**V.O.C.:** The calculated weight of volatile organic content in gramme per litre. An equivalent figure is given in lbs per US gallon.

Alternatively, VOC can be indicated by a measured value. Products that may be used for buildings in the European Union are covered by the EU directive 2004/42/EC. For such products information indicates the maximum level of VOC that the product can have in any colour, it indicates the maximum VOC that the product may have after adding the maximum recommended amount of thinner – and it indicates the EU limits for the product category as of 2007 and 2010.

**Shelf life**: The time the product will keep in good condition when stored under cover in original, sealed containers under normal storage conditions. Shelf life is indicated only if it is one year or less at 25°C/77°F. It will decrease at higher temperatures, eg will be almost halved at 35°C/95°F. Long-term storage and storage at high temperatures may require careful remixing of the paint prior to application due to (slight) sediment in the can. If storage conditions are unknown and in any other case in doubt about suitability of a paint material this can be rather easily verified by checking the following:

**a.** no corrosion of the inside unopened, undamaged cans

**b**. apparent viscosity in can: after remix, paint must not appear gelatinous or require excessive thinning prior to proper application.

**c**. application in specified film thickness: a uniform, closed paint film is to be demonstrated

**d**. drying time to be within the limit specified in the product data sheet

**Storage temperature**: In order to maintain application properties as designed, paints should not be stored at temperatures above 50°C/122°F prior to application.

**APPLICATION DETAILS**

**Mixing ratio:** Two-component, chemically curing products are supplied as BASE and CURING AGENT in the correct mixing ratio. The mixing ratio must be strictly adhered to, also when subdividing. As a general rule, add the CURING AGENT to the BASE 10 minutes (induction time) before use (at 20°C/68°F), unless the pot life is (very) short, and stir well. This is especially of importance when applying paints to low-temperture surfaces. In certain cases, more specific advice is given as to induction time. It is very important for two component products that the prescribed amount of CURING AGENT is added to the BASE. In order to ensure this the indicated thinner may in most cases beneficially be used to flush the CURING AGENT can. Once the material has been mixed the curing will proceed. Therefore, only the quantity needed within the pot life of the mixture should be mixed at a time.

**Application method:** Gives the possible or recommended method(s) of application. As a general rule, the first coat of a rust-preventing primer should be applied by brush or airless spray to obtain best possible wetting and penetration into the substrate. Application by brush or roller usually demands more coats applied to achieve the specified film thickness than application by airless spray equipment.

**Thinner (max.vol):** The amount of thinner to be added, depends on prevailing temperature, spray method, etc. The usual maximum percentage is indicated for the respective application method. If more thinning is deemed necessary under special circumstances, consult nearest Abolin Co. office. Adding a small percentage of thinner will give no measurable difference in the film thickness. There are cases, however, when a higher degree of thinning is necessary and justified. It should then be kept in mind that adding thinner increases the quantity of liquid paint without contributing to the solids content. Consequently, a proportionally higher wet film thickness must be applied when adding any significant amount of thinner in order to obtain the specified dry film thickness.

**Pot life:** Roughly speaking, the pot life for solvent-borne paints depends on the paint temperature as follows:

The pot life is halved at an increase in temperature of 10°C/18°F, and doubled at a decrease in temperature of 10°C/18°F. For some products the pot life is usually shorter for application by airless spray than for brush application. This is due to the fact that the anti-sagging properties are gradually lost after expiration of the pot life indicated for airless application. Thus the high dry film thickness usually specified by airless spray application is only obtainable within the pot life indicated for airless application.

Note**:** Pot life cannot be extended by thinning. In the case of water-borne, two-component epoxy products this rule of thumb will not fit. The temperature's influence on the pot life is noted in the relevant data sheets.

**Nozzle orifice**: A typical nozzle orifice (or a range of nozzle orifices) is indicated.

**Nozzle pressure**: A nozzle pressure generally suitable is given.

Note: Airless spray data are offered as a guidance and are subject to adjustment to suit the work at hand.

**Indicated film thickness, dry:** Dry film thickness (dft) is indicated in a thickness frequently used in specifications. Note: Several products are specified in different film thicknesses for different purposes Checking of dry film thicknesses is, generally, done with gauges calibrated on smooth reference steel panels.

**Indicated film thickness, wet:** Wet film thickness (wft) is indicated in multiple of 25 micron (1 mil) in order to facilitate the practical measurements with the wet film thickness gauge (comb gauge). These values are rounded off to the multiple of 25 which is regarded most relevant in each case.

**Recoat interval**: The time required or allowed to pass at 20°C/ 68°F or the relevant temperature range for the product in question before the subsequent coat is applied. The intervals are related to the temperature, film thickness, number of coats, type of future (in service) exposure and will be affected correspondingly. For maximum intervals the temperature in this context is the highest surface temperature during the period. For some products the interval is more critical in regard to intercoat adhesion than others. If the maximum interval is exceeded it may be necessary to roughen the surface to ensure adhesion of the next coat. On the other hand, for some paint types the interval may not be critical in respect of adhesion, but a primer coat should not be left unprotected for too long in an aggressive environment.

If nothing else is mentioned the indicated intervals refer to recoating with the same paint. Other paints of different types may require other (recoating) intervals. Minimum and any maximum intervals should always be adhered to if the paint system is to provide maximum protection. Furthermore, beware of undesired influence of moisture and carbon dioxide on epoxy and polyurethane paints, which especially occurs at low temperatures and high humidity. This will result in a greasy surface preventing any adhesion of the subsequent coat.

After exposure of any painted surface in polluted environment thorough cleaning by high pressure fresh water hosing or another appropriate measure is always recommended before recoating. Different minimum and maximum recoating intervals are given forcertain products depending on the later exposure.

**SURFACE PREPARATION:** The recommended degree of cleaning of the surface before painting. The degrees of cleaning refer to ISO 8501-1:2007. Pictorial Surface Preparation Standards for Painting of Steel Surfaces, unless otherwise indicated.

For some products a minimum surface profile is mandatory. The profile so specified is given with reference to one or more of the roughness comparators: Rugotest No. 3, Keane-Tator Comparator, or the ISO Comparator. For previously painted surfaces the method and degree of preparatory cleaning is generally indicated.

**APPLICATION CONDITIONS:** If climatic or other limits, beyond what is dictated by normal good painting practice, apply to the use of a particular quality of paint, this is indicated under this heading. As a general rule, paint should never be applied under adverse weather conditions. Even if the weather seems fit for painting there will be condensation if the temperature of the substrate is at or below the dew point (the temperature at which the atmospheric humidity condenses, e.g. as dew). To compensate for fluctuations the temperature of the surface should be at least a few degrees above the dew point during painting and drying. 3°C/5°F is often quoted as safe. Beware of ice on the surface at temperatures below the freezing point.

In confined spaces it may be necessary to remove solvent vapours or water vapours by providing an adequate amount of fresh air constantly during application and drying, both for reasons of safety and health, and to assist evaporation. Keep the paint temperate (room temperature) when applying during winter. If not, the paint will require excessive thinning leading to an increased risk of sagging. Viscosity in any paint will increase if the temperature decreases.

**PRECEDING COAT**: Recommendations of some preceding paint(s) known to be compatible with the product. No limitation is implied. Other compatible products may be specified depending on the purpose. preparation.

**SUBSEQUENT COAT**: Recommendations of some subsequent paint(s) known to be compatible with the product. No limitation is implied. Other compatible products may be specified depending on the purpose.

**REMARKS**: Under this heading other relevant data or information are included.

**SAFETY**: Under this heading general safety precautions when handling or working with the product are given. Packings are provided with applicable safety labels which should be observed. In addition, Material Safety Data Sheets, national or local safety regulations should always be followed.

Note: The product data sheets are subject to change without notice and automatically void five years from issue.

**Additional notes and definitions of some expressions may be used in the product data sheets:**

Surface cleaning*

**Low pressure water cleaning:** up to 340 bar/5000 psi

**High pressure water cleaning:** 340-680 bar/5000-10.000 psi

**High pressure water jetting:** 680-1700 bar/10.000-25.000 psi

**Ultrahigh pressure water jetting:** above 1700 bar/25.000 psi

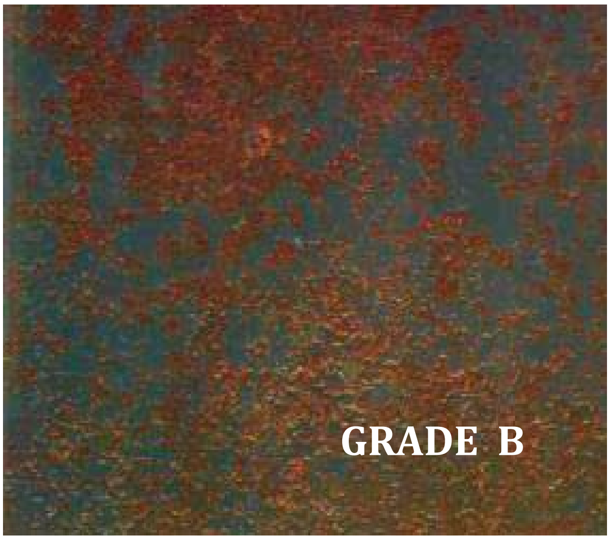
***As defined in "Joint Surface Preparation Standard NACE No. 5/SSPC-SP 12, 1995".**

Note: Wet abrasive blasting may be performed with low or high pressure fresh water to which a relative small amount of abrasives is introduced, and in some cases inhibitors are added to prevent flash rusting (however, as a general rule it is recommended not to use inhibitors when cleaning areas to be immersed during service. Surplus of inhibitors may lead to osmotic blistering). A blast primer is a paint used for short term protection of a newly blast cleaned steel surface of an assembled structure in order to ease the working procedures. In this context blast primers are often regarded an integral part of the surface preparation. A holding primer is a paint used to prolong (hold) the protective lifetime of a shopprimer till the specified paint system proper can be applied. To apply a mist coat or flash coat is a two step application procedure used to minimize popping when painting on a porous substrate. At first, one or two spray passes are applied very thin to expel the air from the pores. As soon as this thin coat has flashed off, the film is built up to the specified film thickness. A tiecoat is a layer of paint which improves the adhesion between coatings of different generic types, eg to "bridge" between conventional and advanced coatings, or between epoxy and physically drying paints. A sealer coat is a layer of paint which is used to seal off (fill the pores of) porous surfaces.  When paint is mentioned to be resistant to spillages and splashes of certain chemicals it is understood to be limited in both area and time. The spilt chemical must be removed as soon as possible and not remain on the surface more than 1-2 days.

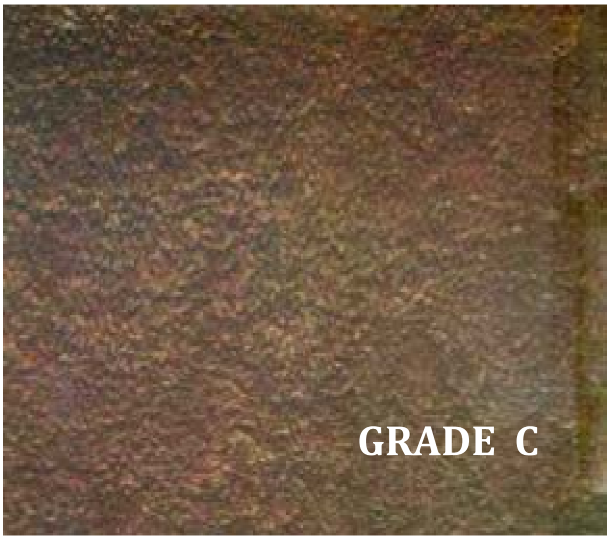
# ANNEX

**ISO 8501-1 Pictorial Standards of Cleanliness ISO 8501-1 is a pictorial standard relating to surface cleanliness, amongst other methods, though abrasive blasting. The original condition of steel surfaces prior to blasting are depicted in various stages of corrosion as follows:**

**GRADE A**



**GRADE B**

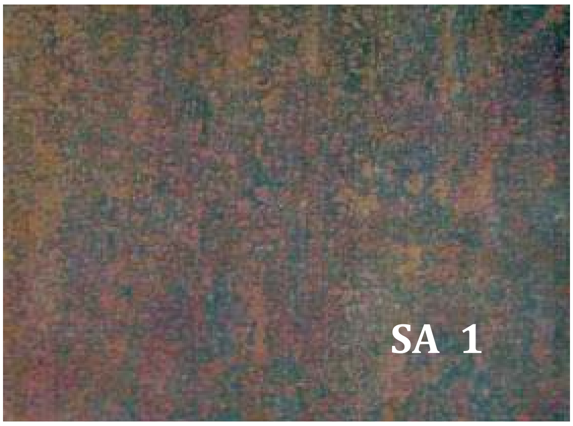


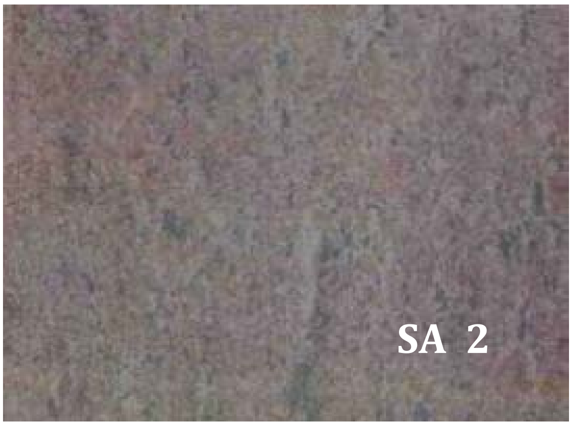
**GRADE C**

**GRADE D**

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

**Blast-cleaning to Sa Standards Blast cleaning to ISO 8501-1 Sa standards is a commonly used specification with pictorial and written guidelines as follows:**





**Sa 1 Light blast -cleaning** When viewed without magnification, the surface shall be free from visible oil, grease and dirt. And from poorly adhering mill scale, rust, paint coatings and foreign matter.

**Sa 2 Thorough blast-cleaning** When viewed without magnification, the surface shall be free from visible oil, grease and dirt and from most of the mill scale, rust, paint coatings and foreign matter. Any residual contamination shall be firmly adhering.

**Sa 2½ Very thorough blast-cleaning** When viewed without magnification, the surface shall be free from visible oil, grease and dirt and from mill scale, rust, paint coatings and foreign matter. Any remaining traces of contamination shall show only as slight stains in the form of spots or stripes.

**Sa 3 Blast-cleaning to visually clean steel** When viewed without magnification, the surface shall be free from visible oil, grease and dirt and from mill scale, rust, paint coatings and foreign matter. It shall have a uniform metallic colour.