SURFACE PREPARATION STANDARDS

Among the several existing official and unofficial standards for cleaning of steel preparatory to painting, one - viz.

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 2 1/2, 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 It is now superseded by INTERNATIONAL STANDARD ISO 8501-1:1988. Yet with the same photos as used by the SIS standard plus additionally four photos (flamecleaning) from the 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BRITISH STANDARDS INSTITUTION; Surface Finish of Blast-cleaned steel for Painting: (BS 4232 but now superseded by BS 7079)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
DIN 55928, Protection of steel structures from corrosion by organic and metallic coatings; preparation and testing of surfaces (Germany)

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 and the German Standard 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 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 "Joint Surface Preparation Standard NACE No. 5/SSPC-SP 12" from 1995.

For comparison of the standards see the following pages. The text of the individual Standards are quoted literally.

Issued:

ISO 8501-1:1988

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). 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 hydrojetting 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: 1988.

Issued:

SSPC

Designation	**Description**
SSPC-SP-5	**2.1** 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. **2.2** ACCEPTABLE VARIATIONS IN APPEARANCE THAT DO NOT AFFECT SURFACE CLEANLINESS as defined in Section 2.1 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. **2.3** When painting is specified, the surface shall be roughened to a degree suitable for the specified paint system. **2.4** Immediately prior to paint application the surface shall comply with the degree of cleaning as specified herein. **2.5** 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	**2.1** 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 2.2. **2.2** 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. **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, 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.

Issued:

SSPC

Designation	Description
	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-7	**2.1** 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.
	2.2 The entire surface shall be subjected to the abrasive blast. The remaining mill scale, rust, or paint shall be tight.
	2.3 When painting is specified, the surface shall be roughened to a degree suitable for the specified paint system.
	2.4 Immediately prior to paint application, the surface shall comply with the degree of cleaning as specified herein.
	2.5 SSPC-Vis 1-89 or other visual standards of surface preparation may be specified to supplement the written definition.
SSPC-SP-2	**2.1** Hand tool cleaning is a method of preparing steel surfaces by the use of non-power hand tools.
	2.2 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.
	2.3 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.

DIN 55928 is not quoted (translated) but is fully in line with ISO 8501-1:1988 (except for the extra standards as mentioned before).

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".

Joint Surface Preparation Standard NACE No. 5/SSPC-SP 12:

Surface preparation and cleaning of steel and other hard materials by high and ultrahigh pressure water jetting prior to paint application.

WJ visual preparation grades:

WJ-1	Removal of all previously existing visible rust, coatings, millscale and foreign matters to a uniform matt metal finish.
WJ-2	UHP WJ cleaning to a uniform matt finish with at least 95% of the surface area being free of all previously existing visible residues and the remaining 5% only containing randomly dispersed stains of rust, coatings and foreign matters.
WJ-3	HP WJ or UHP WJ to a uniform matt finish with at least two-thirds of the surface being free of all visible residues (except millscale) and the remaining one-third only containing randomly dispersed stains of previously existing rust, coatings and foreign matters.
WJ-4	Uniform removal of all loose rust, millscale and loose coatings.
SC-1	An SC-1 surface is free from all detectable contaminants as determined by using available field test equipment whose sensitivity approximates laboratory equipment. Contaminants relevant in this standard are chlorides, iron-soluble salts and sulphates.
SC-2	An SC-2 surface has less than 7 microgram/cm² chloride contamination, less than 10 microgram/cm² of soluble ferrous ions and/or less than 16 microgram/cm² sulphate contamination as verified by field or laboratory analysis using reliable, reproducible test equipment.
SC-3	An SC-3 surface has less than 50 microgram/cm² chloride and sulphate contaminants as verified by field or laboratory analysis using reliable, reproducible test equipment.

Note: For SSPC the **written** specification takes preference - for ISO 8501-1:1988, the photos.

Definition of flash rust degree (Hempel standard):

Qualitative description

HEMPEL defines:

FR-1	A surface which, after surface preparation, has rusted to form a yellow-brown layer, but in such a small amount that the initial surface condition can just faintly be seen. The rust may be evenly distributed or it may appear scattered over the surface. Furthermore, the rust layer is well adhering and will not readily come off to leave marks on a dry hand, which is swept over the surface with a gentle pressure.
FR-2	A surface which has rusted to form a red-brown layer and in an amount that hides the initial surface condition. The rust may be evenly distributed or it may appear scattered over the surface. Furthermore, the rust is reasonably well adhering and only minor amounts will come off to leave marks on a dry hand, which is swept over the surface with a gentle pressure.
FR-3	A surface which has rusted to a heavy red-brown layer that covers the surface completely. The rust is evenly distributed over the surface. Furthermore, the rust is loosely adhering and will easily come off and will leave significant marks on a dry hand, which is swept over the surface with a gentle pressure.

Issued:

Quantitative description

With the purpose of establishing a reference, HEMPEL has developed a tape test to distinguish between the different flash rust degrees FR-1, FR-2 and FR-3, as defined above.

Procedure

1. Select a spot on which to perform the test.
2. Attach a piece of tape (as specified in ASTM D 3359) in a length of at least 5 cm (2") and rub thoroughly with a fingertip - not a nail - to make the tape adhere firmly.
3. Peel off the tape and place it on a piece of white paper for reference.
4. Repeat steps 2. and 3. 9 times on exactly the same spot using a new piece of tape each time.

Assessment (after the 10th piece of tape)

The flash rust degree is assessed on the basis of the amount and type of rust present on the 10th piece of tape and on the appearance of the test-spot relative to that of the adjacent areas.

HEMPEL defines:

FR-1	No rust on the tape.
	No or only a slight change of the test-spot.
FR-2	Slight localized red-brown rust on the tape.
	A significant change of the test-spot, possibly showing localized areas of black rust.
FR-3	Significant, uniform red-brown rust on the tape, also showing grains of black rust.
	A significant change of the test-spot, also showing localized areas of black rust.