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Issue	Reason for Revision	Author	Checked/ Approved
01 : 04/09	1 st issue in new format for standards. Replaces 2.42 Issue 1 dated 18.06.81.	TJB	MC
02 : 04/11	Number changed in accordance with new company document numbering policy.	TJB	MC
03 : 01/12	Revision history table revised to include checked/approved initials.	TJB	MC
04 : 11/13	J & E Hall International Requirements updated to reflect change in standard paint specification JEH-ES-15-001 and to include requirements for preparation of internal surfaces of pipes and vessels. Title changed.	TJB	MC
05 : 12/16	J & E Hall International Requirements updated to reflect change in standard paint specification JEH-ES-15-001. Updated standards.	SRY	PB
06 : 01/21	Updated to include the requirements of BS EN ISO 12944-4.	CHWG	SRY
Table 1 Revision History			

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1. Introduction

This guide describes the standards of preparation for steel surfaces prior to the application of a protective coating (paint) and specifies the requirements that the surfaces of steelwork for J & E Hall Internationals packaged units, pipes and vessels must be prepared to.

2. Scope

The surface finish requirements within this guide are applicable to all package units, plant and other equipment supplied by J & E Hall International. Where a different standard of surface preparation and/or convention is to be used, as requested by the customer at the sales tendering stage, the Project Engineer shall specify these requirements in the manufacturing data.

The responsibility for ensuring compliance with this standard rests with the fabricator/erector of the package unit or plant with inspection by J & E Hall International.

The standard of surface finish described applies to all carbon steel surfaces: pipes, structural steel (for example, baseframes) and vessels, including internal and external surfaces.

3. General Requirements

The primary objective of surface preparation is to remove all material which negatively affects corrosion protection and to obtain a surface of adequate roughness that permits the complete adhesion of the coating (paint) to the surface. This process will also assist in reducing the level of contaminants that contribute to corrosion.

4. Standards

There are five widely accepted standards for surface preparation published by the following bodies:

- SSPC – Society for Protective Coatings (formally the Steel Structures Painting Council);
- NACE International – National Association of Corrosion Engineers;
- ISO – International Organization for Standardization;
- SIS – Swedish Standards Institute;
- BSI – British Standards Institute.

While each body uses different terminology to grade the finish required for surface preparation, the standards are to a degree interchangeable; refer to Table 2.

	Method of Surface Preparation	Standard Body				
		American SSPC-SP	NACE	ISO 8501-1 SIS 05 59 00	BSI	
					BS7079:2009	BS EN ISO 12944-4:2017
Standard Reference (Type of Surface Preparation and Required Finish)	Solvent cleaning	SP-1	-	-	-	-
	Hand tool cleaning	SP-2	-	St 2	-	St 2
	Power tool cleaning	SP-3	-	St 3	-	St 3
	White metal blast cleaning	SP-5	NACE 1	Sa 3	1st quality	Sa 3
	Thorough blast cleaning	SP-6	NACE 3	Sa 2	3rd quality	Sa 2
	Light blast cleaning	SP-7	-	Sa 1	-	Sa 1
	Very thorough blast cleaning	SP-10	NACE 2	Sa 2½	2nd quality	Sa 2½
	Power tool cleaning to bare metal	SP-11	-	-	-	-

Table 2 Comparison of Recognised Surface Preparation Standards

5. J & E Hall Internationals Surface Preparation Requirements

The standard of finish required for the different types of steelwork of J & E Hall International packaged units, pipes and vessels is detailed in Table 3.

NOTE: Deviation from these requirements may only be made with the written consent of the J & E Hall International Project Engineer and/or Design Department.

Standard	Type of Steelwork				
	Pipework - Internal	Pipework - External	Vessels - Internal	Vessels - External	Structural Steel
BSI 1 st quality/SA3	-	-	-	✓	-
BSI 2 nd quality/SA2 ½	✓	✓	✓	-	✓

Table 3 J & E Hall International Surface Preparation Requirements

6. Surfaces Finishes

Surfaces finishes, as stated in Table 2, and the methods of preparation to achieve the required surface finish are described below.

6.1. Solvent Cleaning (SP-1)

Removal of foreign matter such as oil, grease, dirt, soil, salts, drawing and cutting compounds, and other contaminants from steel surfaces by the use of solvents, emulsions, cleaning compounds, steam or other similar materials and methods which involve a solvent or cleaning action.

6.2. Hand Tool Cleaning (SP-2 and St 2)

Removal of rust scale, mill scale, loose rust and loose paint to a degree achievable by hand wire brushing, hand sanding, hand scraping, hand chipping or other hand impact tools or by a combination of these methods. The substrate should have a faint metallic sheen and be free of oil, grease, dust, soil, salts and other contaminants.

6.3. Power Tool Cleaning (SP-3 and St 3)

Removal of all rust scale, mill scale, loose paint and loose rust to a degree achievable by power wire brushes, power impact tools, power grinders, power sanders or by a combination of these methods. The substrate should have a pronounced metallic sheen and be free of oil, grease, dirt, soil, salts and other contaminants. Surfaces should not be buffed or polished smooth as this will impair the adhesion of any coating applied to it.

6.4. Blast Cleaning

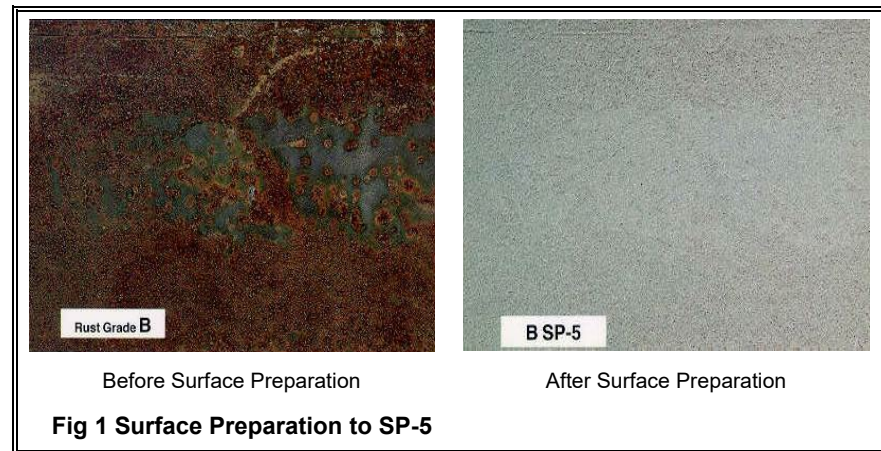
The blast cleaning process removes mill scale, rust, rust scale, paint and foreign matter by the use of abrasives using one of the methods specified and described in ISO 8504-2.

6.4.1. White Metal Blast Cleaning (SP-5, Sa 3, NACE 1 and 1st Quality)

NOTE: This is the standard that the external surfaces of vessels must be prepared to.

A White Metal Blast Cleaned Surface Finish is defined as a surface with a light grey, uniform metallic colour, slightly roughened to form a suitable anchor pattern for coatings. The surface, when viewed without magnification, shall be free of all oil, grease, dirt, visible mill scale, rust, corrosion products, oxides, paint or other foreign matter.

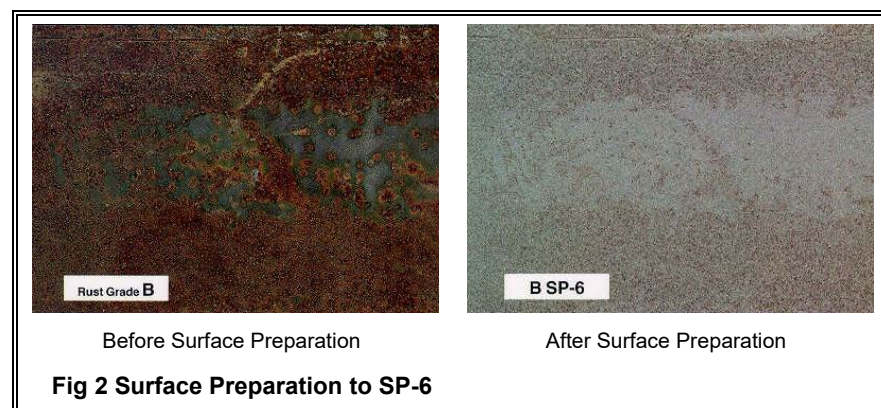
Fig 1 illustrates the surface finish expected when a surface is prepared to the SSPC SP-5 standard, which is equivalent to British Standard 1st quality.



6.4.1. Thorough Blast Cleaning (SP6, Sa 2, NACE 3 and 3rd Quality)

A Thorough Blast Cleaned Surface Finish is defined as one from which all oil, grease, dirt, rust scale and foreign matter have been completely removed from the surface and all rust, mill scale and old paint have been completely removed except for slight shadows, streaks, or discolorations caused by rust stain. Mill scale oxides or slight, tight residues of paint or coatings may remain. If the surface is pitted, slight residues of rust or paint may be found in the bottom of pits; at least 60 % of each 25 mm x 25 mm square of surface area shall be free of all visible residues and the remainder shall be limited to the light discoloration, slight staining or tight residues previously described.

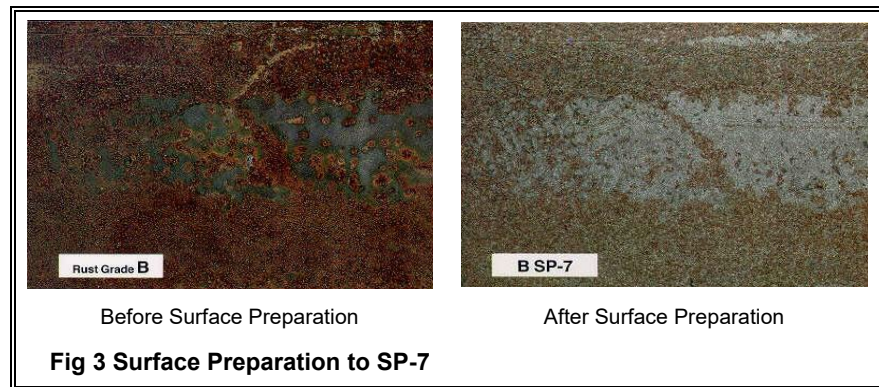
Fig 2 illustrates the surface finish expected when a surface is prepared to the SSPC SP-6 standard, which is equivalent to British Standard 3rd quality.



6.4.2. Light Blast Cleaning (SP-7 and Sa 1)

A Light Blast Cleaned Surface Finish is defined as one from which all oil, grease, dirt, rust scale, loose mill scale, loose rust and loose paint or coatings are removed completely and the surface sufficiently abraded to provide good adhesion and bonding of paint. Tight mill scale and tightly adhered rust, paint and coatings are permitted to remain if all mill scale and rust have been exposed to the abrasive blast pattern sufficiently to expose numerous flecks of the underlying metal fairly uniformly distributed over the entire surface.

Fig 3 illustrates the surface finish expected when a surface is prepared to the SSPC SP-7 standard.

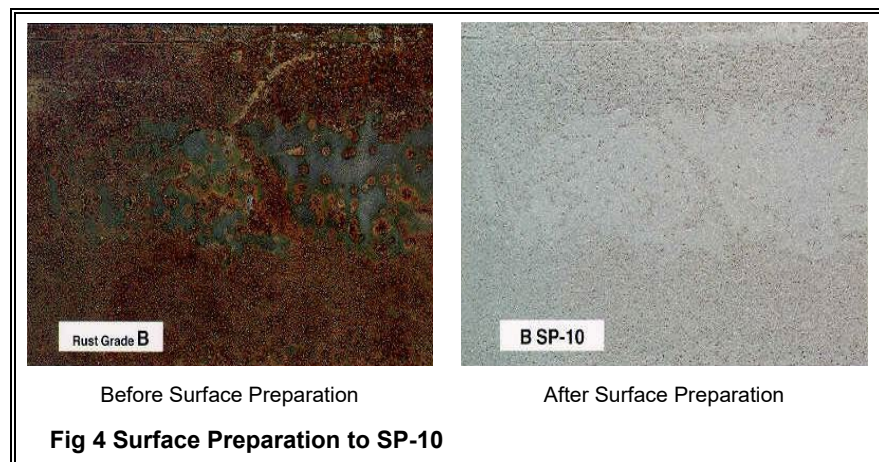


6.4.3. Very Thorough Blast Cleaning (SP-10, Sa 2 ½, NACE 2 and 2nd Quality)

NOTE: This is the standard that the external and internal surfaces of pipes, internal surfaces of vessels and all structural steel for packaged units must be prepared to.

A Very Thorough Blast Cleaned Surface Finish is defined as one from which all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter have been completely removed from the surface except for very light shadows. Very slight streaks or slight discolorations caused by rust stain, mill scale oxides, or light, tight residues of paint or coating may remain. At least 90 % of each 25 mm x 25 mm square of surface area shall be free of all visible residues, and the remainder shall be limited to the light discoloration previously described.

Fig 4 illustrates the surface finish expected when a surface is prepared to the SSPC SP-10 standard which is equivalent to British Standard 2nd quality.



6.5. Power Tool Cleaning to Bare Metal (SP-11)

Metallic surfaces prepared according to this specification, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust mill scale, rust, paint, oxide, corrosion products and other foreign matter. Slight residues of rust and paint maybe left in the lower portion of pits if the original surface is pitted. When painting is specified, the surface shall be roughened to a degree suitable for the specified paint system. The surface profile shall not be less than 25 microns.

7. Surface Preparation Methods

The following provides a guide to the methods used in the surface preparation of steelwork.

WARNING

Suitable protective clothing must be worn when preparing the surface of any steelwork. This should include goggles, gloves etc., and the appropriate face mask.

When using solvents a respirator may also be required – refer to the manufacturer of the solvent. Solvents must only be used in a well ventilated area and any wash-down water must be collected and disposed of in accordance with local/national regulations.

7.1. Degreasing and Contaminant Removal

Before wire brushing or blast cleaning it is necessary to remove all contaminants such as salts, industrial pollutants, greases, oils etc. Wherever salts and industrial pollutants are likely to be present the steel should be thoroughly washed with tap water and dried.

Degrease the metal by using a proprietary degreasing solvent, to remove solvent-soluble foreign matter from the surface of the metal. Rags and solvents must be replenished frequently to avoid spreading the contaminants rather than removing them. After degreasing, the steel shall be thoroughly washed down with tap water and dried.

7.2. Scraping and Wire Brushing

Loose mill scale, rust and foreign matter shall be removed by thorough scraping, wire-brushing, machine brushing, grinding, etc. until only firmly adhered residual contamination remains on the surface. Finally, use a vacuum cleaner, clean dry compressed air or a clean brush to clear the surface of dust.

7.3. Blast Cleaning

Mill scale, rust and foreign matter shall be removed by thorough blast cleaning until the required grade of finish is attained. Finally, use a vacuum cleaner, dry compressed air or a clean brush to clear the surface of dust.

7.4. Pickling and Phosphating

NOTE: Consult with the paint manufacturer and the phosphate treatment specialist to check the suitability of this process for the intended material and paint system to be used.

For steelwork that is to be supplied un-painted for assembly at site it is advantageous to have the steel pickled and phosphated by specialists. The pickling process involves submerging the metal in a mineral acid which removes any impurities, stains, rust and scale from the surface.

The phosphating process provides a corrosion resistant layer on the metal surface, which is a good key and suitable for most paints. A dilute solution of phosphoric acid and phosphate salts is applied, via spraying or immersion, which chemically reacts with the surface of the metal to form a layer of insoluble, crystalline phosphates.

7.4.1. Non-ferrous Metal Aluminium

The surface should be clean, dry and grease-free. 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 coat should be removed and treated with a proprietary aluminium pre-treatment solution, and the acid etch primer then re-applied.

7.4.2. Galvanised Steel

The surface should be clean, dry and grease free. 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. An acid etch solution or etch primer should be used to passivate the surface and provide a key for further paint 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.

7.4.3. Other Non-ferrous Metals

The surface should be clean, dry and grease free. 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.

8. Preservation

After surface preparation, the exposed raw metal surface shall be kept in an atmosphere where the ambient temperature is greater than 10.0 °C and relative humidity is less than 85 %. Under no circumstances must water be allowed to wet the prepared surface. Within a maximum of four hours following surface preparation, three hours for outdoor marine and industrial applications, the metal must be sealed by an appropriate primer; refer to JEH-ES-15-001 for the paint specification.

9. References for Further Information

Organisation	Web Address
J & E Hall Engineering Standards JEH-ES-15-001 Standard Paint Finishes for Package Units. JEH-ES-15-005 Painting Stainless Steel.	-
Society for Protective Coatings (SSPC) Offer a full range of surface preparation standards.	www.sspc.org
National Association of Corrosion Engineers (NACE) Offer a full range of surface preparation standards.	www.nace.org
Swedish Standards Institute (SIS) SIS 05 59 00 (1967) - Pictorial Surface Preparation Standards for Painting Steel Surfaces.	www.sis.se
British Standards Institution (BSI) BS 7079 General introduction to standards for preparation of steel substrates before application of paints and related products. BS EN ISO 12944-4 Paints and varnishes – Corrosion protection of steel structures by protective paint systems. Part 4:Types of surface and surface preparation.	www.bsigroup.com
International Organization for Standardization (ISO) ISO 8501-1 Preparation of steel substrates before application of paints and related products -- Visual assessment of surface cleanliness -- Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.	www.iso.org
Revision numbers and/or issue dates correct at date of issue. The latest revision of a document or its applicable replacement where it has been superseded shall apply.	
Table 4 References for Further Information	