

16 PAINTING SPECIFICATION

16.1 General

- 16.1.1 This specification covers the materials, tools, facilities and quality requirements for surface preparation and painting of steelwork, equipment, including pipe work, ductwork etc. The requirements brought out herein are applicable both for shop painting and painting at the site.
- 16.1.2 Surface directly embedded in concrete, asbestos, aluminium, brass, bronze, galvanized steel, stainless steel and other corrosion resistant alloys, rubber / synthetic polymers, and buried pipe work are not required to be painted unless specified, except for identification bands, where relevant. Except for such surfaces, painting and surface preparation shall be provided to protect all surfaces that shall be subject to atmospheric action and exposed to corrosive media, irrespective of mention in the other General and Technical Specification.
- 16.1.3 Painting shall provide a continuous adherent film of adequate thickness on the surface being treated and atmosphere prevailing at the site and exposures in other corrosive environment. The climatic conditions of site are outlined in the Site Data. The work shall consist of surface preparation and application of primer, intermediate and finish coats of organic and inorganic coating or metallic coating as specified herein. The scope of works include painting of colour bands, lettering, marking & signs for direction of flow/rotation, names etc. of approved colours as per the standard colour codes and specifications specified in tender specification or as advised by PURCHASER engineer at site.
- 16.1.4 This specification shall be read along with the following three (3) Annexures enclosed with this specification:
- | | | |
|---------------|---|-------------------------------|
| Annexure-16.1 | : | Surface preparation standards |
| Annexure-16.2 | : | Painting system |
| Annexure-16.3 | : | Colour code |

16.2 Standards

- 16.2.1 All materials, tools and workmanship shall be in accordance with the latest editions of relevant Bureau of Indian Standard / International Standards. The work shall conform to generally accepted codes of practice for good painting, based on specifications such as those published by Steel Structures Painting Council (SSPC-SP), USA or NACE (National Association of Corrosion Engineers (NACE), USA) or DIN 55928 or ISO 8501-1& 2 : 2007, BS 4232 or SIS-05.

16.3 Surface Preparation

- 16.3.1 Surface preparation being a pre-requisite for any paint application, shall be such as to clean the surface thoroughly of any materials which will be conducive to premature failure of the paint sub-strata.
- 16.3.2 All surfaces shall be cleaned of loose substances and foreign materials, such as dirt, rust, scale, oil, grease, welding flux etc. irrespective of whether the same has been spelt out in the standards in order that the primer coat is rigidly anchored to the virgin metal surface. The surface cleaning shall conform to pictorial representation of surface quality grade of Swedish Standards Institution SIS-05-5900 or ISO 8501-1 & 2 or equivalent standards such as SSPC-VIS ii-1.67 or DIN 55928 (Part IV) or BS:4232 standards of surface preparation quality grade to be adopted in respect of SIS 055900 are presented in Annexure 10.1 for ready reference. A copy of pictorial representation of surface quality shall be made available at site for reference and inspection. Any oil, grease, dust or foreign matter deposited on the oil surface after preparation shall be removed and care taken that the surface is not contaminated with acids, alkalies, moisture or other corrosive chemicals. The primer coat shall be applied within 4 hours on completion of all the surface preparation
- 16.3.3 The acceptable surface preparation standards are described under each paint system. The procedures covered are solvent cleaning, hand tool cleaning, power tool cleaning, flame cleaning, blast cleaning, pickling or combination thereof. These are briefly described below.
- 16.3.4 The surface preparation quality such as St-2, St-3, Sa-2, Sa-2 1/2 etc. shall be compatible with the selection of primer paint and overall life of the paint system adopted.
- 16.3.5 The paint manufacturer's instruction shall be followed as far as practicable at all times. Particular attention shall be paid to the following.
- a. Proper storage of paint to avoid exposure as well as extremes of temperature.
 - b. Surface preparation prior to painting.
 - c. Mixing and thinning.
 - d. Application of paints and the recommended limit intervals between coats.
 - e. Shelf life for storage.
- 16.3.6 Solvent Cleaning
- The surface is cleaned by wiping, immersion, spraying or vapour contacting of a suitable solvent or washing with emulsion or alkaline

solution or chemical paint stripper. The method effectively removes oil, grease, dirt, matters but does not remove rust, scales, mill-scales or weld flux. Also, hydrocarbon solvents do not remove corrosive salts such as chloride and sulphate. Therefore, before application of paint, solvent cleaning is commonly to be followed by other cleaning procedures.

16.3.7 Hand Tool Cleaning

The surface is cleaned by vigorous wire brushing done manually to St-2 quality. Chipping and scraping is usually carried out before wire brushing; oil and grease are removed by solvent cleaning before hand tool cleaning. On welded work, before wire brushing, particular care should be taken to remove by blasted cleaning, washing with water, phosphate rinsing of power tool cleaning as much welding flux, slag and fume deposit as is possible. This method effectively removed loosely adherent materials but would be not affect residues of rust or mill scales that are intact and firmly adherent.

16.3.8 Power Tool Cleaning

The surface is cleaned by electric or pneumatic tools, such as brushes, sanding machines, sanding discs, abrasive grinders, chipping, hammers, needle guns and rotary de-scalers to St-3 quality. Oil and grease are first removed by solvent cleaning and heavy rust scale removed prior to use of power tools. The tools are used carefully to prevent excessive roughening of surface and formation of ridges and burrs; also, care is taken to avoid mill scale being burnished to a smooth, slick surface. This method will remove loosely adherent material but would not affect residues of rust, or mill-scales that are intact and firmly adherent.

16.3.9 Flame Cleaning

The surface is cleaned by rapid heating up by means of oxy-acetylene flame to loosen the adherent scales, followed immediately by wire brushing. Oil and grease are first removed by solvent cleaning and all accessible welding flux and spatters removed before application of flame. The surface is also cleaned of all unbound mill-scale and dehydrated by the passage of oxy-acetylene flame adjusted to have neutral characteristics. This method will remove loosely adherent materials as well as most of the scales and mill scales. In order to minimize or prevent distortion, flame cleaning shall not be used on members having thickness of 6 mm or lower.

Note : During flame cleaning method overheating and damaging of parent materials are strictly restricted.

16.3.10 Blast Cleaning

The surface is cleaned by impingement of abrasive materials, such as graded sand or grit of cast iron, malleable iron, steel or synthetic material, at high velocity created by clean and dry compressed air blast. Blast cleaning shall be carried out on dry surfaces using dry air, free from impurities (in particular grease or oils), in an atmosphere where relative humidity is less than 80%, and the ambient temperature above 5°C. The abrasive used for blast cleaning shall produce an average keying profile on the blast cleaned surfaces of not more than 40 microns. An air pressure of 7 bar (g) at the nozzle shall be used. No blast cleaned surface shall be allowed to remain uncoated overnight. The abrasive material shall be free of foreign matter such as clay, humus, chlorides & bitumen. Prior to application of the blast, heavy deposits of oil and grease are removed by solvent cleaning and excessive surface scale removed by hand tool or power tool cleaning. This method will remove loosely adherent materials as well as adherent scales and mill-scales. The extent of removal of adherent scales is varied, depending on the application, and is defined by the surface quality grades Sa-1, Sa-2 and Sa-2&1/2 and Sa-3 in the order of increasing cleanliness. All surfaces that are blast cleaned shall be coated with a primer coat within 4 hours. The surface cleanliness requirements of ISO 8501-1 or SIS 055900 shall be maintained.

16.3.11 Pickling

In this method the surfaces is cleaned of mill-scales, rust and rust scales by chemical reaction or electrolysis or both. Normally the pickling is done in a bath of dilute sulphuric, hydrochloric or phosphoric acid, with or without heating, followed by thorough rinsing with fresh water to remove the acid traces. Pickling in sulphuric acid may be followed by dipping in phosphoric acid containing iron phosphate. Prior to pickling heavy deposits of oil, grease, soil, drawing compounds and foreign matters other than rust, scales or oxides are removed by solvent cleaning. This method will remove loosely adherent as well as adherent scales and mill-scales.

16.3.12 Removal of abrasives and debris

In all cases, after surfaces preparation, all traces of loose materials shall be removed from the surface by compressed air or vacuum cleaning. Cleaned surfaces shall not be contaminated with oil, grease, rust or other deposits before coating.

16.4 Paint Materials

16.4.1 The paint systems specified herein and listed in Annexure 15.2 for different exposure conditions shall be the minimum acceptable quality of surface protection against the respective environment, provided the paint

materials are manufactured from quality products under stringent quality control. For any proprietary paint formulation, the performance of which has been tested in actual site conditions or under stimulated conditions in test laboratory, the manufacturer's recommendations in all respects shall be adhered to.

16.4.2 The vehicle for the specified paint products of a particular system for the respective service exposure conditions shall be one of or a combination of the following to provide a compatible paint system as a whole:

- i. Synthetic enamel of oil-alkyd based or acrylic modified alkyds or styrenated alkyd.
- ii. Modified phenolic alkyd.
- iii. Chlorinated rubber.
- iv. Two component epoxy-polyamide free of alkyds and plasticiser.
- v. Two component epoxy-polyamide for stove drying.
- vi. Two component polyurethane
- vii. Silicone
- viii. Bituminous
- ix. Coal tar epoxy

16.4.3 The rust inhibitive pigments shall be any one of or a combination of the following depending on the nature of exposure and compatibility with other ingredients present in the selected vehicle:

- i. Red lead (about 96% Pb 304, 4% PbO)
- ii. Zinc Chromate (about 38% ZnO, 44% CrO₃)
- iii. Zinc Phosphate
- iv. Manganese Phosphate with Barium Chromate
- v. Zinc Dust (about 96% Zn)
- vi. Non-leafing aluminium

Red lead pigment shall not be used in case of paint being sprayed.

16.5 Mixing and Thinning of Paint

- 16.5.1 All ingredients in a paint container shall be thoroughly mixed to break-up lumps and disperse homogeneity. Mixing shall be mechanical except when the container size is 20 liters or less; mixing by air bubbling is not permitted. All pigmented paints shall be strained after mixing to remove skins and other undesirable matters.
- 16.5.2 For two pack products, both components shall first be mixed separately then together to ensure complete dispersion and mixing. During application, the coating shall be agitated sufficiently often with a power mixture to maintain pigments and extenders in suspension.
- 16.5.3 Coating materials shall never be left in spray equipments container overnight or for any considerable period of time, but put back into their can & remixed prior to using again. If skin is formed it must be removed, if the skin is thicker than 1mm the product will be discarded.
- 16.5.4 Coatings shall be filtered after mixing unless the painting equipment used is fitted with adequate filters
- 16.5.5 Dry pigments, pastes, tinting and colours shall be mixed and / or made into paint so that all dry powders get wetted by vehicles and lumps and particles are uniformly dispersed.
- 16.5.6 Additives that are received separately, such as curing agents, catalysts, hardeners etc. shall be added to the paint as per manufacturer's instructions. These shall be promptly used within the pot life specified by the manufacturers and unused paint thereafter discarded.
- 16.5.7 Thinners shall not be used unless essential for proper application of the paint. Where thinners are used, they shall be added during the mixing process and the type and quantity of thinner shall be in accordance with the instructions of the paint manufacturer. In the case of two component paints, the thinner shall be added after the mixing together of two components
- 16.5.8 Storage of Paint
- 16.5.8.1 All paints shall be stored strictly in accordance with requirements laid down by the paint manufacturer. Outdoor storage for instance next to application site is acceptable only for quantities to be used on a particular day and providing weather protection and provision for cover are made. The storage area shall be well ventilated and protected from sparks, flame,

direct exposure to sun or excessive heat, preferably located in an isolated room or in a separate building. Recommended storage temperature : 5 to 40 deg centigrade

16.5.8.2 All paint containers shall be clearly labeled to show at the time of use the paint identification, instructions in legible form. The containers shall be opened only at the time of use. Paints which have livered, gelled or otherwise deteriorated during storage shall not be used. Paints for which the shelf life specified by the manufacturer has expired, shall not be used.

16.5.8.3 All paint materials shall be stored in tightly sealed condition, and never stored unprotected outdoors or exposed to direct sunlight. Paint materials can's shall only be opened immediately before use. Paints which have gelled or in which sediments have formed during storage shall be discarded. Paint materials shall be issued from storage on a first in first out base.

16.6 Paint Application

16.6.1 General

16.6.1.1 Paint shall be applied in accordance with manufacturer's recommendations as supplemented by this specification and the work shall generally follow as per Bureau of Indian Standard / International standard.

16.6.1.2 Paint shall generally be applied by brushing except that spraying may be used for finish coats only when brushing may damage the prime costs. Roller coat or any other method of paint application shall not be used unless specifically authorized. Spraying shall not be adopted on red lead or zinc rich paints. The primer & subsequent coat of each painting system shall be of the same make.

16.6.1.3 Paint shall generally not be applied when the ambient temperature is 5°C and below; for paint, which dry by chemical reaction, the temperature requirements specified by the manufacturer shall be met with. Also, paint shall not be applied in rain, wind, fog or at relative humidity of 80 percent and above or when the surface temperature is below dew point resulting in condensation of moisture. Any wet paint exposed to damaging weather conditions shall be inspected after drying and the damaged area repainted after removal of the paint. Paint application shall not be carried out if ambient temperature reaches or exceeds 55°C

16.6.1.4 Each coat of paint shall be continuous, free of pores and of even film thickness without thin spots. The film thickness shall not be so great as to affect detrimentally either the appearance or the service of the paint. Runs or sags shall be brushed out before surface drying of paints. If paints have

been allowed to dry, any sags and runs shall be scraped off and the areas re-painted.

- 16.6.1.5 Each coat of paint shall be allowed to dry sufficiently before application of the next coat to avoid damage such as lifting or loss of adhesion. Undercoats having glossy surface shall be roughened by mild sand papering to improve adhesion of subsequent coat. Successive coats of same colour shall be tinted, whenever practical, to produce contrast and help identify the progress of work.
- 16.6.1.6 The edges/corners, weld seams and other difficult areas are to reach needs touch has to be done before every full coat in order to maintain same dry film thickness uniformly.
- 16.6.1.7 Maturation time is an important criteria for two pack product where curing takes place through chemical reaction when the components are mixed before application. Normally, the mixed is matured for about 30 mins, unless other specified, to initiate the reaction process which ensure thickness build up and proper drying of the paint film.
- 16.6.1.8 No coat shall be applied until the preceding coat dries off completely. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed max. specified for it as a first coat; if it exceeds the paint material has possibly deteriorated or mixing is faulty.
- 16.6.1.9 No paint shall be forced dried under conditions, which will cause cracking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.
- 16.6.1.10 No drier shall be added to paint on the job unless specifically called for in the manufacturers specification for the paint.
- 16.6.1.11 The application of paint by brush or spray are covered below:

16.6.2 Brush Application

- 16.6.2.1 Proper brushes shall be selected for a specific work piece. Round or oval brushes, complying with international standard are better suited for irregular surfaces whereas flat brushes complying with international standard are convenient for large flat areas. The width of flat brushes shall not generally exceed 125 mm.

- 16.6.2.2 Paint shall be applied in short strokes depositing uniform amount of paint in each stroke followed by brushing the paint into all surface irregularities, orifices and corners and finally smoothing or leveling the paint film with long and light strokes at about right angles to the first short strokes. All runs and sags shall be brushed out. The brush marks shall not be left in the applied paint as far as practicable.

16.6.3 Spray Application

- 16.6.3.1 The spraying equipment shall be compatible with the paint material and provided with necessary gauges and controls. The equipment shall be cleaned of dirt, dried paint, foreign matter and solvent before use.
- 16.6.3.2 The paint shall be applied by holding the gun perpendicular to the surface, at a suitable distance and moved in a pattern so as to ensure deposition of an uniform wet layer of paint. All runs and sags shall be brushed out immediately; areas not accessible to spray shall be painted by brush or dauber.

16.6.4 Shop Painting

- 16.6.4.1 All fabricated steel structures shall have a minimum of two primer coats before dispatch to site. The paint shall be applied immediately after surface preparation to the specified quality, preferably within two hours.
- 16.6.4.2 Surface in contact during shop assembly shall not be painted. Surfaces in contact after field erection shall receive three shop coats of specified primer unless the paint will interfere with assembly. Surface which will be inaccessible after assembly shall also receive three shop coats of specified primer. Surfaces which cannot be painted but required protection shall be given a coat of rust inhibitive grease shall be confirmed to International standards.
- 16.6.4.3 Surfaces to be in contact with concrete shall not be painted. Surfaces to be in contact with wood, brick or other masonry shall be given one shop coat of the specified primer.
- 16.6.4.4 The shop coats shall be continuous overall edges including ends meant for joining at site by welding, except where the paint is harmful to welding operator or is detrimental to the finished welds. In such cases, the prepared welding edges and the joint zone are coated with epoxy based weldable blast primer over a width of approximately 50 mm. Then the welding edge and the joint zone are covered with an adhesive tape over a width of approximately 50 mm and the work piece is coated with full coats of shop painting. Then the adhesive tape is removed. The welding edges and the joint zones are not coated with primer / rust inhibitive

compounds and intermediate coats since the complete removal of these layers in the site cannot be guaranteed, but is absolutely vital for the quality of the welds.

- 16.6.4.5 Small machinery, motors, electrical equipment and instruments etc. shall receive the full specified coats of paint in the shop.
- 16.6.4.6 Large machinery, large motors, cranes, gear cases, conveyors etc. shall be shop painted completely as per the relevant paint system taking into account the exposure conditions.
- 16.6.5 Site / Field Painting
 - 16.6.5.1 After the erection / assembly of fabricated structures at the plant site, damaged and defective shop coats shall be touched up with the same type of paint as used for shop coat. The work shall include removal of damaged paint work, surface preparation of the damaged area (due to damage of shop coat or due to site fabrication or transportation) to St-3 quality and painting thereof to cover-up all field connections, welds, rivets and all damaged or defective paint and rusted areas. The fabricated steel structures shall then be painted with finish coats as specified. Preferably spot repairs shall be carried out such that the painting extends atleast 50 mm beyond the damaged area.
 - 16.6.5.2 If necessary, equipment and large machinery shall be give one finish coat compatible with shop coats after necessary cleaning and touch up.
 - 16.6.5.3 The first coat of paint at site shall be applied before weathering of the shop coat becomes excessive, preferably within three months of the shop coat. The finish coat of paint shall be applied after all concrete work has been complete and all cement and concrete spatters and drippings removed and damaged surfaces touched up before application of the finish coat.
 - 16.6.5.4 If in the opinion of the **PURCHASER**, the damage to shop cost is extensive, then instead of spot touch up one overall coat of primer for each shop coat shall be applied after cleaning. Surfaces which have not been shop coated but require to be painted shall be given the necessary surface preparation and prime coat before application of intermediate and finish coats and before any damage occurs to the surface from weather or other exposure.
 - 16.6.5.5 Steel structures which are fabricated at site shall be painted with prime and finish coats after necessary surface preparation as specified after fabrication and erection at site.
 - 16.6.5.6 All cracks and crevices shall be filled with compatible paint or putty.

16.6.5.7 All field welds and all areas within 50 mm of welds shall be cleaned before painting, using surface preparation method as specified to attain the specified surface quality grade; in any event all welds shall either be blast cleaned, or thoroughly power wire brushed or chemically scrubbed or solvent cleaned depending on the nature of the weld deposits.

16.6.5.8 During application of paint at site care shall be taken to protect any damage to building, floors, structures, electrical equipment including motors, valve stems, glass, moving parts, bearings, couplings, shafts, lubrication points and other sensitive parts. Any paint falling on or applied to such surfaces shall be removed.

16.7 Hot Dip Galvanizing

Hot Dip Galvanizing is a process in which an adherent, protective coating of zinc and zinc compounds is developed on the surfaces of iron and steel products by immersing them in a bath of molten zinc. The protective coating usually consists of several layers. Those closest to the basis metal are composed on iron-zinc compounds, these, in turn, are covered by an outer layer consisting of zinc. The hot dip galvanizing process shall conform to ASTM 123 or BS EN ISO 1461 or equivalent standard. All Hot dip galvanizing shall be preceded by the necessary surface preparations, including pickling.

16.8 Colour Code

16.8.1 Shades of finish paint coat to be applied shall be as per Indian Standard or Munsell colour reference (published by Munsell Colour Co Inc, Baltimore, USA). Shades of finish coat of major item like steel structures, equipment and piping are specified in Annexure 15.3. However, prior approval shall be taken from the **PURCHASER** after placement of order before adopting final colour shade for any particular item being painted.

16.9 Inspection and Testing

16.9.1 The CONTRACTOR shall ensure that the surface treatment and painting carried out meets the requirements of the relevant painting systems specified. The CONTRACTOR shall furnish to the PURCHASER test certificates, inspection test reports to conform compliance to the standards specified. Bidder has to submit necessary QAP, procedure & methodology of painting before the commencement of the work/painting

16.9.2 Paint manufacturer's test certificates to show the quality of materials used in the paint shall be furnished.

- 16.9.3 The inspection and test reports shall include but not limited to the following essential information; grade of surface preparation, paint system adopted, name of paint manufacturer, dry film thickness of each coat as measured.
- 16.9.4 The inspection and test reports shall include but not limited to the following essential information;,, grade of surface preparation, result of visual inspection, paint system adopted, name of paint manufacturer, dry & wet film thickness of each coat as measured in ambient parameters such as humidity, temperature, dew point etc. paint colour & consistency, surface profile and adherent test.
- 16.9.5 The **CONTRACTOR** should ensure that, during blast cleaning, coating, the relative humidity shall not exceed 80% and the ambient temperature shall be above 5°C and less than 50°C.
- 16.9.6 The **CONTRACTOR** shall arrange suitable measuring instruments, required in the process of painting, such as comb gauge(WFT) Comparator, Surface profile gauge, elkometers (with calibration facilities) whirling hygrometer, dew point calculator, etc as and when required.)
- 16.9.7 Final inspection shall include visual, colour of shade, paint consistency test, measurement of paint wet & dry film thickness, adhesion and Holiday detection check of finish and workmanship .The thickness should be measured at as many points / locations.)
- 16.9.8 The thickness of each coat shall be as defined in Annexure 10.2. 90% of random readings shall be equal to or greater than the specified thickness. No individual reading shall be less than 90% of the specified thickness for each coat in a given system. Where excessive film thicknesses can be detrimental to the integrity of the coating, the manufacturer's recommended shall be complied with.
- 16.9.9 The thickness measurement of hot dip galvanizing shall be in accordance with EN ISO 1460 or equivalent international standard.
- 16.9.10 All coating thickness on metal substrates shall be measured in accordance with ASTM E376 or equivalent standard. Thicknesses of non-metallic substrates shall be checked by verification of the quantity of coating consumed.
- 16.10 Safety precaution**
- 16.10.1 **CONTRACTOR** should ensure necessary safety measures while doing surface preparation, painting & galvanizing. Proper earthing shall be

provided for the electrical equipment. Any spillage of volatiles shall be wiped off immediately.

16.10.2 CONTRACTOR shall ensure the availability of necessary safety tools (PPE), equipments and first aid kit at work place.

16.10.3 CONTRACTOR shall ensure the availability of necessary safety tools (PPE), equipments and first aid kit at work place.

16.10.4 **CONTRACTOR** shall provide all the necessary scaffolding materials, temporary structures and necessary safety devices etc. during execution of the work

16.11 SAFETY NORMS

16.11.1 During removal of oil, grease, rust & scale from surface appropriate apron, gloves, respirators & safety glasses shall be used by the operator.

16.11.2 During Painting

- a. Each primer and epoxy paints are liable to cause irritation to the skin. This may transpire into inflammation, swelling, rash or pustules on the hands, arms & occasionally on the whole body. Therefore task performers should wear hand gloves & aprons during painting.
- b. Work place & storage rooms shall be adequately ventilated.
- c. Before starting works, hands should be washed with soap & water and good barrier cream applied.
- d. Utmost care should be taken to avoid splashes on the skin.
- e. Splashing on the skin should be immediately washed with soap & water
- f. After the work hands, faced & arms should be washed with soap & water, followed by thoroughly drying with a clean cloth.

Annexure 16.1 – Equivalent Standards for Surface Preparation Grade

Sl No	Surface preparation	Pictorial representation of Swedish Std SIS 055900	DIN 55928 (Part 4)	SSPC Std.	BS Std. BS:4232	IS 1477 Part -1	NACE Standard
1	Blast Cleaning to white metal: Removal of all visible rusts, mill-scales, paint and foreign matters	Sa3	Sa3	SSPC -SP-5	First quality	CI A1.2	No. 1
2	Blast cleaning to near white metal : 95% of any section of surface area is free from all rusts, mill-scales and visible residues	Sa 2 ½	Sa 2 1/2	SSPC -SP-10	Second quality	CI A1.2	No. 2
3.	Blast cleaning to commercial quality : At least 2/3 of any section of the surface area is free from all rusts mill-scales, and visible residues	Sa 2	Sa 2	SSPC -SP-6	Third quality	CI L 1.3	No. 3
4.	Brush-off blast cleaning : Removal of all loose mill scales, rust and foreign matters etc.	Sa 1	Sa 1	SSPC -SP-7	-----	CI A 1.4	No. 4

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Sl No	Surface preparation	Pictorial representati on of Swedish Std SIS 055900	DIN 55928 (Part 4)	SSPC Std.	BS Std. BS:42 32	IS 1477 Part -1	NACE Standar d
5.	Power tool cleaning : Very thorough scrapping and wire brushing to remove loose mill-scale, rust and foreign matters to have pronounced metallic shine	St-3	St-3	SSPC -SP-3	-----	CI 6.2.1.2	-----
6.	Hand tool cleaning : Removal by hand brushing of loose mill-scale, loose rust and foreign matters	St-2	St-2	SSPC -SP-2	-----	CT 6.2.1.1	-----

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Annexure 16.2 – Painting System

System No.	Description	Nature of Exposure	Treatment in the Shop			Paint System	Surface Quality	Treatment at Site		Paint System	Total DFT in micron (shop & site)
			Surface Quality	No.of Coats	DFT / Coat in microns (P/F)			No.of Coats	DFT / Coat in microns		
1	General Service Painting	Normal Atmospheric environment non-corrosive atmosphere									
1.(I)	Structural steel work for plant, buildings, pipe trestles etc. location - all indoor temperature less than 80 Deg.C		St 3	2P + 1F	35 / 30	Alkyd base red oxide zinc chromate / zinc phosphate primer F-Synthetic enamel of long oil alkyd resin based paint	Clean and re-touch	1 F	30	F-Synthetic enamel of long oil alkyd resin based paint	130
1.(II)	Steel doors, windows etc. of regular handling		Sa 2	2P + 1F	50 / 30	P-Zinc chromate based modified phenolic alkyd or alkyd high build zinc phosphate primer F-Polyurethane enamel or long oil alkyd synthetic enamel	Clean and re-touch	1 F	30	F-Polyurethane enamel or long oil alkyd synthetic enamel	160

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System No.	Description	Nature of Exposure	Surface Quality	No.of Coats	Treatment in the Shop DFT / Coat in microns (P/F) 30 / 50	Paint System	Surface Quality	No.of Coats	Treatment at Site DFT / Coat in microns	Paint System	Total DFT in micron (shop & site)
1.(III)	Outdoor Steel Structures		Sa 2½	1P + 1F		P-Zinc Chromate based modified phenolic alkyd or alkyd high build zinc phosphate primer F-Polyurethane enamel or long fil alkyd synthetic enamel	Clean and re-touch	1 F	50	F-Polyurethane enamel or long oil alkyd synthetic enamel	130
2.0	Wearing Surface Painting	Painting of floor plates, walkways, staircase treads handrailing etc. which are prone to mild abrasion									
2.(I)	Floor Plates / Walkways / Staircase treads etc.		St 2 or St3	-	80 to 90	Hot Dip Galvanizing	-	-	-	* ¹	80 to 90
2.(II)	Hand railing (site fabricated)	Industrial	St 3	-	80 to 90	Hot Dip Galvanizing	-	-	-	* 1	80 to 90
3.0	Light corrosive service painting	Industrial - atmosphere in tropical climate, or mild corrosive environment due to presence of mild acidic fumes and gases from neighboring plant									

¹ Any damage to the Galvanized surface at the site shall be repaired with spray galvanizing.

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System No.	Description	Nature of Exposure	Treatment in the Shop			Paint System	Surface Quality	Treatment at Site		Paint System	Total DFT in micron (shop & site)
			Surface Quality	No.of Coats	DFT / Coat in microns (P/F)			No.of Coats	DFT / Coat in microns		
3.(I)	Structural steelwork for plant / shop building; or storing liquid chemicals / acids; temperature less than 80 Deg.C		Sa 2½	2P + 1F	50 / 30-40	P-High build chlororubber based zinc phosphate primer F-Chlororubber paint	Clean and re-touch	1 F	30-40	F-Chlororubber paint	160-180
3.(II)	Miscellaneous technological steel structures such as conveyor galleries, pipe trestles etc. indoor service temperature less than 80 Deg.C		St 3	2P + 1F	45-50 / 30	P-High build alkyd based zinc phosphate primer F-Chlororubber paint or long oil alkyd synthetic enamel	Clean and re-touch	1 F	30	F-Chlororubber paint or long oil alkyd synthetic enamel	150-160
3.(III)	Manufactured equipment and its associated structures such as vessels, bunkers, exchangers, heaters, furnaces, pumps, crane, stacks etc. - Non-insulated: temperature less than 80 Deg.C		Sa 2½	2 P +1F	50 / 40-50	P-High build chlororubber based zinc phosphate epoxy primer F-Chlororubber paint	Clean and re-touch	1 F	40-50	F-Chlororubber paint	180-200
	- Insulated surfaces										
	Temperature less than 80 Deg.C		St 3	Same as of non-insulated surface but without any finish coat			Clean and re-touch				140-150
3.(IV)	Overground pipe work inclusive of pipe, fittings, hangers, cable ducts, gas ducts etc.										
	Non-insulated pipe work:										

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System No.	Description	Nature of Exposure	Surface Quality	Treatment in the Shop No.of Coats	DFT / Coat in microns (P/F)	Paint System	Surface Quality	Treatment at Site No.of Coats	DFT / Coat in microns	Paint System	Total DFT in micron (shop & site)
	- Indoor and outdoor temp. less than 80°C		St 3	2 P + 1F	40 / 30	P-High build alkyd based zinc phosphate primer F-Chlorinated rubber with weather resisting pigments	Clean and re-touch	1 F	30	F-Chlorinated rubber with weather resisting pigments	140
	Insulated pipe work:										
	- Indoor and outdoor temp. less than 80°C		St 3	2 P	40	P-High build alkyd based zinc phosphate primer	Clean and re-touch	-	-	No finish coat	80
4.	Hot Surface Painting	Environment may be light corrosive similar to system (3) above									
4.(I)	Temperature 80°C to 120°C non-insulated										
	If colour shade is desired		St 3 or Sa 2½	2P + 1F	25 / 40	P-Epoxy zinc phosphate primer F-Epoxy Polyamide enamel	Clean and re-touch	1 F	40	F-Epoxy Polyamide enamel	130
	(or)										
	No colour reservations		St 3	1F + 1F	25 / 25	F-Bituminous aluminium paint	Clean and re-touch	1 F	25	F-Bituminous aluminium paint	75
4.(II)	Insulated: temperature 80°C - 120°C		St 3	2 P	25	P-Epoxy Zinc Phosphate Primer	-	-	-	-	50

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System No.	Description	Nature of Exposure	Surface Quality	Treatment in the Shop		Paint System	Surface Quality	Treatment at Site		Paint System	Total DFT in micron (shop & site)
				No.of Coats	DFT / Coat in microns (P/F)			No.of Coats	DFT / Coat in microns		
4.(III)	Temperature above 120°C non-insulated	For all Environment	St 3 or Sa 2½	1 P	20	P-Silicone aluminium paint	Clean and re-touch	1 F	20	F-Silicone aluminium	40
4.(IV)	Temperature above 120°C insulated		St 3 or Sa 2½	1 F	20	F-Silicone aluminium paint					20
5	Mill Machineries, Heavy Equipment Accessories										
5.(I)	Temperature upto 120°C		Sa 2½	2 P	25-30	P-Two component epoxy polyamide zinc chromate					
				2 F	40-50	F-Two component epoxy polyamide enamel	Clean and re-touch	1 F (Optional)	40-50	F-Two component epoxy polyamide enamel	170-210
5.(II)	Light Machineries, such as 2-mill roll grinders, general workshop machineries, machine tools etc.	Light corrosive environment due to handling of mineral oils, vegetable oils, grease et.c	Sa 2	2 P	25-30	P-Phenolated alkyd with zinc chromate					
				1 I	40 - 50	I-Phenolated alkyd based undercoat	Clean and re-touch				140-170
				2 F	25-30	F-High glass styrenated alkyd enamel					
6	Switchboard / Control Panel Painting	For all environment									

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System No.	Description	Nature of Exposure	Surface Quality	Treatment in the Shop		Paint System	Surface Quality	Treatment at Site		Paint System	Total DFT in micron (shop & site)
				No.of Coats	DFT / Coat in microns (P/F)			No.of Coats	DFT / Coat in microns		
6.(I)	This includes fabricated sheet metal items such as switchboard, control panel, control desks, cabinets, starters, small electric machineries etc.		Pick-ling or Sa 2 1/2 phos-phate treat-ment	1 P	25	P-Zinc chromate - buryrated melamine - alkyd resin baking primer					75
				1 I		I-Aninoalkyd resin putty					
				2 F	25	F-Aninoalkyd resin baking enamel					
6.(II)	Electric motors, transformers etc. - Indoor and outdoor installation - Temperature less than 150°C		Sa 2 1/2	2 P	25-30	P-Two component epoxy polyamide zinc chromate	Clean and re-touch	1 F (Optio-nal)	30-40	F-Two component epoxy polyamide or polyurethane	160-240
				1 I	50-60	I-Two component epoxy polyamide					
				2 F	30-40	F-Two component epoxy polyamide or polyurethane					

NOTE:

- Legends surface quality: Surface preparation grade as per SIS 05 5900 or equivalent, P : Primer Coat, I : Intermediate Coat, F : Finish Coat, DFT: Dry film thickness in microns

Annexure 16.3 – Shades of Finish Coat

Shades of finish coat of paint to be applied over respective items as under:

Items painted	Colour
Structures	
Building frames including bracings, side girts, louveres etc.	Aircraft grey
Crane girders	India saffron
Crane stops	Post office red
Gutters	Black bituminous aluminium
Fire escape platforms ladders etc	Signal red
General hand railing, top runners	Lemon yellow
Rung ladders	Lemon yellow
All members blocking passages for movement	Lemon yellow
Trestles, towers and pipe bridges	Dark admiralty grey
Conveyor gallery structures	Aircraft grey
Steel chimneys	Aluminium
Mechanical and Electrical equipment	
General indoor equipment	Opaline green
General outdoor equipment	Dark admiralty grey
Crane bridges, trolleys, hooks etc and other mobile equipment	Base : Lemon yellow Stripes : Black (300 mm wide)
Furnaces	Aluminium
Tanks	Base : Same as for general equipment Stripes : Same shade as for piping around the tank as half the tank height
Fire fighting equipment	Signal red

Pipework :

Colours shall be as given below. The base colour shall be applied throughout entire length except, on surfaces of materials such as asbestos, aluminium, brass, bronze, galvanized steel, stainless steel and other corrosion resistant alloys and rubber / synthetic polymers. In such cases identification colour bands of at least 500 mm width shall be provided near each branch, valve and at distances not exceeding 10 m either as local colour coatings or coloured adhesive tape of suitable material or label attached to the pipe work. Additional identification bands superimposed over the base colour shall be provided near each branch, valve and at a distance not exceeding 10 m, the bands shall be at least 25 mm wide except in case of double bands where the first band shall be about 100 mm wide.

Direction of flow shall be clearly marked on the pipelines at intervals not exceeding 10 m and at all branches and change of direction;

Items painted	Colour		
River water (untreated)	Base	-	Sea green
	Band	-	white
Cooling water	Base	-	Sea green
	Band	-	French blue
Boiler feed water	Base	-	Sea green
Condensate	Base	-	Sea green
	Band	-	Light brown
Drinking water	base	-	Sea green
	first band	-	French blue
	Second band	-	Signal red
Industrial water	base	-	Sea green
	Band	-	Light orange
Compressed air	Base	-	Sky blue
Instrument air	base	-	Sky blue
	Band	-	Light brown
Steam			
a. Very high pressure steam	base	-	Aluminium
	band		Silver Green
b. High pressure steam	base	-	Aluminium
	band	-	French Blue
c. Medium Pressure Steam	base	-	Aluminium
	band	-	Gulf Red
d. Low pressure steam (SL)	base	-	Aluminium
	band	-	Canary Yellow
Transformer oil	base	-	Light brown
	band	-	Light orange
Fuel oil	base	-	Light brown
	band	-	Signal Reds
L.P. gas	base	-	Canary yellow
	First band	-	Signal red
	Second band	-	Traffic green
Nitrogen	base	-	Canary yellow
	band	-	Black
Ammonia	base	-	Dark violet
Carbon-di-oxide	base	-	Canary yellow
	band	-	Light grey
Hydroflouric (1) acid (conc.)	base	-	Dark violet
	band	-	Silver grey

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Items painted	Colour		
Fire-fighting system	base	-	Signal red
Rain water down pipes	base	-	Sea green
	band	-	Sky blue
Duct work	base	-	Aluminium
Lighting conduits	base	-	Black
	band	-	Yellow
Instruments - conduits	base	-	Black
	band	-	Red
Power - conduits	Base	-	Black