

RASHTRIYA ISPAT NIGAM LIMITED

**VISAKHAPATNAM STEEL PLANT
VISAKHAPATNAM**

VSP-6.3/GS-P-01/R1

**GENERAL SPECIFICATION
FOR**

PAINTING

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**M. N. DASTUR & COMPANY (P) LTD
CONSULTING ENGINEERS**



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**GENERAL SPECIFICATION
FOR
PAINTING
FOR
VISAKHAPATNAM STEEL PLANT**

1.0 GENERAL

1.1 This specification covers materials, tools, facilities and quality requirements for surface preparation and painting of steelwork, equipment, including piping, ductwork etc for Visakhapatnam Steel Plant expansion at Visakhapatnam. The term 'Painting' referred herein covers rust preventive and decorative organic, inorganic and metallic coating and surface protection of the following:

1.1.1 Structural steelwork including building frames, technological structures and surfaces of floor plates, steel doors, windows etc subject to regular handling or use.

1.1.2 Various static and moving equipment including cranes, electric motors, electrical panels, control desks and accessories, and road vehicles.

1.1.3 Steel tanks, vessels, bins, towers, furnaces and stacks.

1.1.4 Pipework including valves, fittings, supports, hangers etc.

1.1.5 Metallic ductwork such as ventilation ducts, gas ducts including supports, hangers etc.

1.2 The term 'surface' used herein shall mean iron and carbon steel surfaces (including castings) exposed to atmospheric action and/or to corrosive media unless otherwise stated. Painting shall be applied after specified surface preparation to protect all surfaces even in cases where no painting requirement is mentioned, in any other General or Technical Specification.



1.3 Surfaces in direct bonded contact with concrete, asbestos, aluminium, brass, bronze, galvanised steel, stainless steel and other corrosion resistant alloys and rubber/synthetic polymers, and buried pipework are not required to be painted unless specified, except for identification bands, where relevant. Corrosion protection of buried pipe work will be as stipulated in VSP.6.3/GS-M-01/R1 for pipe work. For brass and bronze surfaces, formation of an oxide layer on the surface renders excellent corrosion resistance properties. However galvanized steel, aluminium and stainless steel surfaces can be solvent cleaned and painted for protection against chemical atmosphere and surface appearance. 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 Specifications.

1.4 Painting shall provide a continuous adherent film of adequate thickness on the surface being treated and protect it from attack due to continuous exposure in industrial atmosphere prevailing at sites located inland or in marine environment, and exposure in other corrosive environment. The climatic condition of site is outlined in the TSs.

1.5 In case a Vendor/Contractor proposes to adopt paint systems other than those specified herein (whose performance in his opinion will be equal to or better than that of the paint systems specified here), he shall obtain prior approval of the Purchaser.

1.6 The work shall consist of surface preparation and application of prime, intermediate and finish coats of organic and inorganic coating or metallic coating as specified herein, and supervision & testing as required, complete in all respect for protection of surfaces. This shall also include required environmental control, and occupational and safety precautions.

1.7 This specification shall be read along with the following five annexures enclosed with the specifications

Annexure-1	..	List of applicable standards
Annexure-2	..	Surface preparation standards
Annexure-3	..	Painting system
Annexure-4	..	Special area painting
Annexure-5	..	Colour code



1.8 This design basis overrides any specification of painting other than those given in technical specifications and Drawings issued by the Purchaser or their Engineers. Specific requirements, in addition, may be spelt out in technical specifications. Such additional requirements are to be read in conjunction with requirements in this general specification. In case of any contradiction, the stipulations in technical specifications and drawings issued by the Purchaser or their Engineers shall override this design basis only to the extent of such contradictions.

2.0 **STANDARDS**

2.1 Painting and surface protection shall be carried out and tested as per the standards laid down in this design basis. The work shall conform to generally accepted codes of practice for good painting based on the latest editions of relevant Indian Standards published by the Bureau of Indian Standards (BIS), wherever applicable, specifications such as those published by Steel Structures Painting Council (SSPC), 4400 Fifth Avenue, Pittsburgh, Pa 15213, USA, or as per DIN 55928. Detailed instructions on such aspects as are not indicated herein shall be as per the codes and practices indicated in the latest specifications of SSPC or DIN or as per the National Standards Institution of the country of origin or the codes of practices recommended by the paint manufacturers of the country of origin. A list of applicable and related standards is given in Annex-1 hereof.

3.0 **SURFACE PREPARATION**

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 substrata.

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 prime 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 equivalent standards such as SSPC-VIS-1.67 or DIN 55928 (Part 4) or BS 4232 or IS:1411 (Part I). In this specification, relative equivalent standards of surface preparation quality grade to be adopted in respect of SIS 055900 are presented in Annexure-2 for ready reference. Any oil, grease, dust or foreign matter deposited on the surface after preparation shall be removed and care taken that the surface is not contaminated



with acids, alkalis, moisture or other corrosive chemicals. The prime coat shall be applied as soon as possible after the surface preparation is completed. The time gap shall not extend 4 hours for relative humidity not exceeding 75 per cent, and within one hour for high relative humidity.

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.

3.3.1 **Solvent Cleaning**

The surface is cleaned by wiping, immersion, spraying or vapour contacting of a suitable solvent or washing with an emulsion or alkaline solution or chemical paint stripper. The method effectively removes oil, grease, dirt, soil, drawing compounds, old paint and other similar foreign matters but does not remove rust, scales, mill scales or weld slag. Also, hydrocarbon solvents do not remove corrosive salts such as chloride and sulphate. Therefore, before application of paint, solvent cleaning is normally to be followed by other cleaning procedures.

3.3.2 **Hand Tool Cleaning**

The surface is cleaned to St-2 or St-3 quality as required, by vigorous wire brushing done manually. 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 shall be taken to remove by blast cleaning, washing with water, phosphate rinsing or power tool cleaning as much welding flux, slag and fume deposit as is possible. This method effectively removes loosely adherent materials but would not affect residues of rust or mill-scales that are intact and firmly adherent.

3.3.3 **Power Tool Cleaning**

The surface is cleaned to St 2 or St3 quality, by electric or pneumatic tools, such as brushes, sanding machines, sanding discs, abrasive grinders, chipping, hammers, descenders, needle guns and rotary descenders. 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.



3.3.4 **Flame Cleaning**

The surface is cleaned by rapid heating up by means of oxyacetylene 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 oxyacetylene flame adjusted to have neutral characteristics. This method will remove loosely adherent materials as well as most of the adherent scales and mill-scales. In order to minimise or prevent distortion, flame cleaning shall not be used on members having thickness of 6 mm or lower.

3.3.5 **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. 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 are defined by the surface quality grades Sa 1, Sa 2, Sa 2½ and Sa 3 in the order of increasing cleanliness. Blast cleaning is not recommended for sheet metal items.

3.3.6 **Pickling**

In this method the surface is cleaned of mill scales, rust and rust scales by chemical reaction or electrolysis or both. Normally, 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.

3.3.7 **Degreasing, Pickling and Phosphating**

Surface preparation for shop painting of sheet metal items like electrical control panels, desks, etc. may be done in seven or nine tank systems of solvent cleaning and pickling, followed by giving the cleaned surface a thin coating (of not less than 5 gm per sq m) zinc, iron or manganese phosphate deposited either by immersion or powder spray.



The phosphate coating shall be tested, when required, by a continuous salt spray as per ASTM B 117, for a period of not less than 96 hours.

4.0 PAINT MATERIALS

4.1 The paint systems specified herein and listed in Annexure-3 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.

4.2 The vehicle for the specified paint system for the respective service exposure conditions shall be one of or a combination of the following:

- i) Synthetic enamel to oil-based alkyd or PVC-copolymer-based alkyd or acrylic modified alkyds or styrenated alkyd
- ii) Modified phenolic resin varnish.
- iii) Chlorinated rubber
- iv) Two component epoxy-polyamide free of alkyd and plasticiser
- v) Two component epoxy-polyamine for stove drying
- vi) Two component polyurethane
- vii) Silicone
- viii) Coal tar epoxy
- ix) Solvent based inorganic zinc silicate

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) Zinc phosphate
- ii) Micaceous iron oxide
- iii) Manganese phosphate with Barium Chromate
- iv) Zinc dust (about 96% Zn)
- v) Non-leafing aluminum



4.4 The contractor shall furnish paint manufacturer's test reports or technical data sheets and safety data sheets pertaining to the paint material selected. The data sheet shall indicate relevant standards, composition in weight percent of pigments, vehicles, VOC, additives, drying time, viscosity, spreading rate, flash point, method of application, quality of surface preparation required, corrosion resistance properties and colour.

4.5 Paint materials shall be procured from suppliers subject to approval by the Purchaser. Recommended paint suppliers are Berger Paints, J&N, Asian Paints and Akzobobel. A list of their products for various primers, intermediates and finish coats will be issued to successful tenders. Other suppliers and their brand names may be permitted, at the discretion of the Purchaser, provided they are as good as or better than those in the schedule and documents are submitted corroborating this.

5.0 MIXING AND THINNING AND STORAGE OF PAINT

5.1 All ingredients in a paint container shall be thoroughly mixed to break-up lumps and disperse pigments before use and during application, to maintain homogeneity. Mixing shall be mechanical except when the container size is 20 litres or less. Mixing by air bubbling is not permitted. All pigmented paints shall be strained after mixing to remove skins and other undesirable matters.

5.2 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.

5.3 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.

5.4 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.

5.5 Storage of Paint

5.5.1 All paints shall be store strictly in accordance with requirements laid down by the paint manufacturer. The storage area shall be well ventilated and protected from sparks, flame, direct exposure to sun or excessive heat, and preferably be located in an isolated room or in a separate building.



5.5.2 Marking of Containers

- Materials shall be delivered in sealed containers clearly labeled with the following information in legible form:
- Manufacturers name, initials or recognised trade mark.
- Title and specification number.
- Whether primer, undercoat or finishing coat.
- Whether for internal or external use, where appropriate.
- Colour reference from BS 4800.
- Method of application.
- Batch number and date of manufacture or re-test.
- Special Instructions
- Specified shelf life

5.5.3 No paint shall be used more than 18 months after manufacture or re-test.

5.5.4 Coating materials other than spray paints, bituminous paints and fine textured masonry paints shall be in containers not exceeding 5 litres capacity.

5.5.5 Containers shall be opened only at the time of use.

5.5.6 Paints which have livered, galled or otherwise deteriorated during storage shall not be used.

6.0 PAINT APPLICATION

6.1 General

6.1.1 Paint shall be applied in accordance with manufacturer's recommendations as supplemented by this specification. The work shall generally follow IS:1477 (Part II) for jobs carried out in India and SSPC-PA-1 or DIN 55928 or equivalent for Jobs carried out outside India.



6.1.2 Primer paint shall generally be applied by brushing/air-less spraying. Brushing is required for application of paint in inaccessible areas. Finish paint shall generally be applied by airless spraying. Roller coat or any other method of paint application shall not be used unless specifically authorised. Daubers may be used only when no other method is practicable for proper application in areas difficult to access.

6.1.3 Paint shall generally not be applied when the ambient temperature is 10°C and below. For paints, 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 per cent and above or when the surface temperature is below dew point resulting in condensation of moisture or during fog, rain or mist. Any wet paint exposed to damaging weather conditions shall be inspected after drying and the damaged area repainted after removal of the paint.

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.

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. Defects such as pinholes, voids, runs, sags, over-spray, orange peel, fish-eye and skins shall be prepared by mild sanding (by hand/power) of the damaged area. 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.

6.1.6 The application of paint by brush or spray are covered below

6.2 **Brush Application**

6.2.1 Proper brushes shall be selected for a specific work piece. Round or oval brushes to IS:487 are better suited for irregular surfaces whereas flat brushes to IS:384 are convenient for large flat areas. The width of flat brushes shall not normally exceed 125 mm.



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, crevices and corners and finally smoothing or levelling 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. Brush marks shall not be left in the applied paint as far as practicable.

6.3 **Spray Application**

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.

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 a uniform wet layer of paint. All runs shall be brushed out immediately. Areas not accessible to spray shall be painted by brush or dauber.

6.4 **Air-less Spray Application**

6.4.1 The equipment for this system must enable a satisfactory application of paint material. With the airless system it must be taken into consideration that the equipment is laid out in such a way as to obtain the required spraying pressure, that the nozzle size corresponds to the recommendation of the paint manufacturer, and that the spray angle is adjusted to the requirements of the surfaces to be painted. The paint must be continuously mixed, and sprayed on evenly cross process (in two directions at 90° angle) whereby the individual layers shall overlap. The spray gun shall always be held perpendicular to the surface to be sprayed, at such a distance that the paint reaches the surface when still moist.

6.5 **Shop Painting**

6.5.1 All fabricated steel structures shall have a necessary primer coats prior to dispatch at site. The paint shall be applied immediately after surface preparation to the specified quality preferably within 2 hours.

6.5.2 Surfaces 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 require protection shall be given a coat of rust inhibitive grease to IS:958 or solvent deposited compound to IS:1153 or 1674 or an international equivalent.

6.5.3 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.

6.5.4 The shop coats shall be continuous over all 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, no paint shall be applied within 50 mm of the welding edge and the unprotected surface shall be given a coat of corrosion inhibitive compound. The unpainted area shall be exposed prior to welding, the welded joint cleaned and deslagged and immediately covered by paint same as that has been used for the remaining surface.

6.5.5 Small machinery, motors, electrical equipment and instruments etc shall receive the full specified coats of paint in the shop.

6.5.6 Large machinery, large motors, cranes, gear cases, conveyors etc shall be shop painted completely as per the relevant paint system taking into account the service conditions.

6.6 **Site/Field Painting**

6.6.1 Structures fabricated at site shall be completely painted upto finish coat before the same is lifted for erection. 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 erection or due to site fabrication) to the specified quality and painting thereof to cover-up all field connections, welds, fasteners and all damaged or defective paint and rusted areas. If in the opinion of the Purchaser, damage to shop primer coats is extensive, then instead of spot touch up, one overall coat of primer for each coat shall be applied after cleaning. The fabricated steel structures shall then be painted with intermediate (where applicable) and finish coats as specified.

6.6.2 Equipment and large machinery pieces shall be despatched from shop after application of specified primer coating, single coat of intermediate and finish coat.



6.6.3 The first coat of paint at site shall be applied before weathering of the top shop coat becomes excessive, preferably within three months of the application of shop coat. The finish coats of paint shall be applied after all concrete work has been completed and all cement and concrete spatters and drippings removed and damaged surfaces touched up before application of the finish coats.

6.6.4 Surfaces requiring painting which have not been shop/yard painted shall be given necessary surface preparation and prime coats before application of intermediate and finish coats and before any damage occurs to the Surface from weather or other exposure

6.6.5 Steel structures, which are fabricated shall be painted with prime and finish coats after specified surface preparation on completion of fabrication and erection.

6.6.6 All cracks and crevices considered not detrimental to mechanical strength shall be filled with compatible paint or putty.

6.6.7 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. All welds shall either be blast cleaned, or thoroughly power wire brushed or chemically scrubbed or solvent cleaned depending on the nature and position of the weld deposits.

6.6.8 During application of paint at site care shall be taken to prevent 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.

6.6.9 Pipes shall be painted till finish coat before lifted for erection. For the purpose of welding, around 15 mm from the welding edge shall remain unpainted. Painting shall be completed after welding of the pipes.

7.0 PAINT SYSTEMS

The paint systems to be followed in general for different service conditions has been classified and listed in Annexure- 3. In addition, some specific areas requiring special attention and the painting system, which has been found to be effective, are listed in Annexure-4 hereof.



7.1 **General Service Painting**

7.1.1 This system is applicable for painting of non-load bearing structure, such as partitions, minor platforms, ladders, walkways etc under normal atmospheric environment, which is fairly clean, dry and non-corrosive.

7.1.2 Surface preparation shall be of SIS grade St-2 hand tool cleaning or St-3 power tool cleaning for oil-based paint and Sa 2½ near white blast cleaning in case PVC-copolymer-alkyd-based paint is used.

7.1.3 The paint system for this service the details of which has been specified in Annex-3 shall be at least two coats of zinc phosphate or equivalent primer and one coat of weather resistant modified phenolic resin varnish with micaceous iron (MIO) as an intermediate coat in the shop and one finish coat or long oil-alkyd resin paint at site after necessary touch-up operation. Alternative paint specification based/on PVC-copolymer alkyd can be used.

7.1.4 Steel doors, windows etc which are subject to regular handling shall have surface preparation to SIS grade St-3 power tool cleaning or pickling. The prime coat as specified in Annex-3, shall be zinc phosphate based - two component epoxy primer and an intermediate coat of epoxy based micaceous iron oxide (MIO). The finish coat at site shall be two component polyurethane (UV resistant), after filling all cracks with putty during application of primer coat.

7.2 **Wearing Surface Painting**

7.2.1 This system covers floor plates, walkways, staircase treads and other similar surfaces for general service.

7.2.2 Surface preparation shall be Sa 2 or Sa 2½ or St-3 depending on nature of exposure and paint system adopted as outlined in Annex-3.

7.2.3 The shop prime coat for light corrosive environment shall be either zinc phosphate PVC-copolymer alkyd enamel or zinc phosphate based epoxy primer. The intermediate coat at shop shall be a compatible paint with micaceous iron oxide. The finish coat at site shall be compatible with prime and intermediate coat that is either PVC-copolymer alkyd or epoxy. Top surface of floor plate shall have higher paint film thickness than bottom.



7.2.4 In case of extreme corrosive atmosphere, the shop primer coat for top and bottom surface shall be two component epoxy polyamide with zinc phosphate/ ethyl silicate based zinc rich primer. One intermediate coat shall be compatible paint with micaceous iron oxide. The site painting shall be two component polyurethane.

7.2.5 For hand railing two coats of zinc phosphate epoxy as a primer and two coats of epoxy polyamide as finish coat shall be applied.

7.3 **Light Corrosive Service Painting**

7.3.1 This system is applicable where marine industrial atmosphere prevails or light corrosive atmosphere exists due to presence of mild corrosive fumes and gases of neighbouring plant. In view of the location of site, the paint system, which shall be generally applicable for most of the equipment and structures shall be covered under this category unless otherwise specified

7.3.2 Painting of all load bearing steel structures, structural steelwork for plant and shop building, equipment, pipework etc which are exposed to such light corrosive atmosphere as detailed in Annexure-3 are covered under this system.

7.3.3 The surface preparation shall be of Sa 2, or Sa 2½ or Sa 3 depending oil nature of paint system adopted.

7.3.4 The paint system under this service as specified in Annexure-3 for respective item shall be any one of the following such as chlorinated rubber, PVC-copolymer alkyd, epoxy polyamide and zinc ethyl silicate and combination thereof depending on nature of exposure conditions, compatibility and durability of paint life

7.3.5 For temperature condition in between 80°C and 150°C zinc ethyl silicate primer shall be used followed by a coat of high build epoxy polyamide enamel.

7.3.6 For temperature condition above 150°C the primer coat shall be zinc ethyl silicate and finish coat shall be silicone-aluminium paint.



7.4 **Extreme Corrosive Service Painting**

7.4.1 This system is applicable where there is extreme corrosive atmosphere prevailing due to presence of inorganic and organic acids, alkalis, corrosive salts, corrosive vapours and fumes, solvents etc.

7.4.2 Painting of all load bearing steel structures, equipment, pipes and ducts, and its fittings which are exposed to such extreme corrosive atmosphere as detailed in Annexure-3 are covered under this system.

7.4.3 The surface preparation shall be Sa 2½ or Sa 3 or St-3 depending on nature of paint system adopted.

7.4.4 The paint system under this service as specified in Annex-3 shall be primarily zinc phosphate based epoxy-polyamide paint as primer coat and micaceous iron oxide as intermediate coat and epoxy-polyurethane as finish coat.

7.4.5 In case of higher temperature service of above 150°C and zinc ethyl silicate shall be used as prime- coat and silicone-aluminium as finish coat.

7.5 **Hot Surface Painting**

7.5.1 This system is applicable when temperature condition under light or extreme corrosive service exceeds 80°C.

7.5.2 The prime coat shall be ethyl zinc silicate or epoxy-polyamide and silicone aluminium as a finish paint the specific application of which has been indicated in Annexure-3.

7.6 **Heavy Machinery and Accessories Painting**

7.6.1 This system is applicable for heavy machinery such as those in rolling mills and accessories, which are subjected to varying exposure conditions and excessive wear.

7.6.2 The surface preparation shall be of Sa 2½ or Sa 3 depending on paint system adopted.

7.6.3 The paint system shall be epoxy polyamide based as specified in Annexure-3.



7.7 Switchboards/Control Panel Painting

7.7.1 This system covers fabricated sheet metal items, namely electrical panels, switchboards, instrument panels, control desks, cabinets etc.

7.7.2 The surface preparation shall be pickling or white blast cleaning to Sa 2½. The clean surface shall be given a phosphate coating consisting of a thin layer of zinc, iron or manganese phosphate deposited either by immersion or powder spray. The coating weight shall not be lower than 5 gm per sq m; the coating shall be tested, when required, by a continuous salt spray as per ASTM B 117.

7.7.3 The phosphate coated surface shall have one coat of baking primer of zinc phosphate - butylated melamine - alkyd resin based and two coats of finish paint of amino-alkyd resin stove enamel as specified in Annex-3.

7.7.4 For large electric drives, transformers etc for indoor and outdoor installation, epoxy polyamide and polyurethane system shall be adopted as indicated in Annexure-3.

7.8 Metallic Coating

7.8.1 This system covers permanent structures namely, transmission towers, outdoor electric substation structures, pipe trestles, poles etc which cannot be conveniently repainted.

7.8.2 The surface preparation shall be degreasing, followed by pickling as per para 3.3.6, and in accordance with IS 2629.

7.8.3 The cleaned surface shall be coated by a layer of zinc by hot dipping, in accordance with IS 4759. The deposition shall be at least 610 gm per sq m for metal thickness of 5 mm and above, and 460 gm per sq m for up to 2 mm metal thickness. Alternatively hot dip aluminium coating can be used, in accordance with IS 6697.

7.8.4 In case hot dip coating can not be applied, sprayed aluminium/zinc coating as per IS 5905 can be applied with the permission of the Purchaser.

7.9 Small Items of Equipment Painting

7.9.1 Standard bought out items and machines such as valves, pumps, cylinders, small motors which are mass production item and are being painted in a production line in the manufacturer's shop, may be painted as per respective manufacturer's standard but



shall meet the requirement of the exposure condition and the specific system of painting thereof as stipulated in this specification. The colour to be adopted for such equipment shall be subject to approval by Purchaser before commencement of manufacture.

8.0 COLOUR CODE

8.1 Shades of finish paint coat to be applied shall be as per 1S:5 or as per 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-5. However, prior approval shall be taken from the Purchaser after placement of order before adopting final colour shade for any particular item being painted.

9.0 INSPECTION AND TESTING

9.1 The contractor shall ensure that the surface treatment and painting carried out meets the requirements of the relevant painting systems specified.

9.2 Testing shall be carried out on materials to be used by the Contractor, as well as work being carried at stages. Record shall be maintained by the Contractor of all such tests and reports submitted to the Purchaser. The Purchaser may examine the test reports, and in addition undertake inspection at any or all stages.

9.3 Manufacturer's test certificates shall be made available by the Contractor for all materials to be used in the works. In addition, the Purchaser reserves the right to call for test of samples at random, reject any batch or lot if the quality thus found is deficient, and the Contractor shall have to bear expenses of testing.

9.4 The inspection and test reports shall include but not be limited to the following essential information which are grade of surface preparation, paint system adopted, name of paint manufacturer, dry film thickness of each coat as measured.

- i) Rust grade
- ii) Grade of surface preparation
- iii) Container identification of each coat of paint applied
- iv) Dry film thickness of each coat



9.5 For the job execution, inspection shall be carried out by the Contractor after each stage of work, namely pre-treatment and each coat of paint. The Contractor shall maintain record of stage inspection, in formats to be approved by Purchaser. Countersignature by Purchaser on these will be required, before proceeding with next stage of work.

9.6 The Contractor shall maintain equipment required for inspection and testing required during job execution. These shall include but not be limited to the following.

- a) Sling psychrometer and electric psychrometer for measuring wet and dry bulb temperatures, digital thermometer for instant air temperature.
- b) Digital and surface temperature thermometer for recording temperature of substrate.
- c) Zahn Cup for measuring viscosity of paint.
- d) Wet film thickness gauge, inter-chemical wet film thickness gauge, Elcometer minitest and quanmix of different models, Positector 6000 for measuring coating thickness, and pocket-size 30X Microscope for examination of coatings.
- e) Pinhole and holiday detectors e.g. Tinker-Razor high and low voltage wet sponge holiday detector, K-D bird dog low voltage wet sponge holiday detector, spy high voltage holiday detector are required to find the nicks, scrapes and pinholes in the coating film.

9.7 Record shall be maintained by the Contractor on inspection of each identifiable part of the work, including but not limited to the following:

In addition, Dew point and relative humidity be shall recorded at the start of work, in the middle of each shift, or at intervals approved by Purchaser.

9.8 The Contractor shall have available, for reference at the work site, a set of essential standards, such as IS 1477 (Parts I & 2), IS 1303, and SIS 055900 (or equivalent ISO, SSPC, BS).



10.0 SAFETY MEASURES

10.1 For safety point of view the persons along with the supervisors who have to do painting, cleaning, shot blasting, etc. must take safety measures as is the normal practice in existing plant. Necessary instructions would be provided by safety engineering department of the Purchaser. The supervisor must follow the safety induction instructions such as use of safety belt, helmet, goggles, apron, mask, etc. while doing the job.

10.2 In addition plant and personnel belonging to the Purchaser and other agencies would be protected from damage due to the painting work to be carried out by the Contractor. This will include, but not be limited to, providing protective barriers/covers at job site, especially when carrying out air blast cleaning.

ANNEXURE-1**APPLICABLE STANDARDS**

Standard No.	Year of Publication (reaffirm)	Title
IS 5	2004	Colours for ready mixed paints & enamels
IS 101	various	Methods of sampling and test for paints, varnishes and related products (several parts & sections)
IS 158	1981(2004)	Ready mixed paint brushing, bituminous black, lead-free, acid, alkali & heat resistant
IS 384	1979(2002)	Brushes, paints & varnishes, flat
IS 430	1972(2004)	Paint remover, solvent type non-flammable
IS 431	1972(2000)	Paint remover, solvent type non-flammable
IS 487	1997	Brushes, paints and varnishes (i) oval ferrule bound and (ii) round ferrule bound
IS 958	2000	Temporary corrosion preventive grease, soft film-spec.
IS 1153	2000	Temporary corrosion preventive fluid, hard film, solvent deposited-specification
IS 1154	2000	Temporary corrosion preventive fluid, soft film, solvent deposited, water displacing-specification
IS 1303	1983(2001)	Glossary of terms related to paints
IS 1477(1)	1971(2000)	Code of practice for painting of ferrous materials in building-pretreatment
IS 1477(2)	1971(2000)	Code of practice for painting of ferrous materials in building-painting
IS 1674		Superseded by IS 1154
IS 2074	1992(2002)	Ready mixed paint, after drying, red oxide zinc chromate, priming-specification
IS 2339	1963 (2004)	Aluminium paint for general purpose use in dual container
IS 2379	1990(2000)	Colour code for identification of pipelines
IS 2395(1)	1994(1999)	Code of practice for painting concrete, masonry and plaster surfaces-operations and workmanship
IS 2395(2)	1994(1999)	Code of practice for painting concrete, masonry and plaster surfaces-schedule
IS 2629	1985 (2001)	Recommended practice for hot dipped galvanising of iron and steel
IS 2932	2003	Enamel, synthetic, exterior: (a) undercoating (b) finishing-specification



Annexure-1 (cont'd)

Standard No.	Year of Publication (reaffirm)	Title
IS 3531	1997(2002)	Glossary of terms relating to corrosion of metals
IS 3618	1966(2002)	Specification for phosphate treatment of iron and steel for protection against corrosion
IS 4759	1996 (2001)	Specification for hot dip zinc coating on structural steel and other allied products
IS 4777	1968(2002)	Performance tests for protection schemes used in protection of light gauge steel sections against corrosion
IS 5555	1970(2002)	Code of practice for conducting field studies in atmospheric corrosion of metals
IS 5905	1989 (2005)	Sprayed aluminium & zinc coating of iron & steel
IS 6005	1998	Code of practice for phosphating of iron and steel
IS 6048		Withdrawn
IS 6049	1971(2002)	Code of practice for application of temporary corrosion preventives
IS 6050	1971(2004)	Specification for temporary corrosion preventives, strippable, hot dipping type
IS 6745	1972 (2001)	Method for determination of mass of zinc coating on zinc coated iron & steel
IS 6697	1988 (2000)	Hot dip aluminium coating on ferrous parts (other than sheets, steels & wires) for general purpose
IS 7808	1975(2002)	Code of practice for conducting underground corrosion of metals
IS 8062 1I)	1976(2002)	Code of practice for cathodic protection of steel structures, general principles
IS 8062 (2)	1976(2002)	Code of practice for cathodic protection of steel structures-underground pipelines
IS 8629(1-3)	1977(2000)	Code of practice for protection of iron and steel structures from atmospheric corrosion
IS 9954	1981(2000)	Pictorial surface preparation standard for painting of steel surfaces
IS 10221	1982 (2003)	Code of practice for coating and wrapping of underground mild steel pipelines
IS 10493	1983 (2002)	Corrosion protection tests for temporary corrosion preventives
IS 13607	1992(2002)	Ready mixed paint, general purpose, synthetic-specification
IS 14191	1996(2000)	Corrosion of metals and alloys-classification of corrosivity of atmosphere



Annexure-1 (cont'd)

Standard No.	Year of Publication (reaffirm)	Title
IS 14209	1994(2004)	Epoxy enamel, two component, glassy-specification
IS 14297	1995(2000)	Corrosion of metals and alloys-corrosivity of atmosphere-determination of corrosion rate of standard specimens for the evaluation of corrosivity
IS 14321	1995(2000)	Corrosion of metals and alloys-recommended values for the corrosivity categories of atmosphere
IS 14322	1996(2000)	Corrosion of metals and alloys-corrosivity of atmosphere-measurement of pollution-methods
IS 14428	1997(2004)	Guidelines for painting of structures in aggressive chemical environment
IS 14506	1998(2003)	Epoxy red oxide zinc phosphate weldable primer, two component-specification
IS 14779	2000	General purpose oil based temporary corrosion preventives-specification
IS 14589	1999(2004)	Zinc priming paint, epoxy based, two pack-specification
IS 14925	2001	Epoxy resin for paints-specification
IS 14946	2001	Zinc ethyl silicate primer, two components-specification
IS 14947	2001	Enamel synthetic, oil resistant air drying-specification
IS 14948	2001	Paint coal tar epoxy, two pack, black and brown (base & hardener)-specification
BS7079(I)	1989(1994)	Specification of rust grades and preparation grades of uncoated steel substrates and of steel substrates after removal of previous coating
-do- supplement 1		Representative photographic examples of appearance imparted to steel blast cleaned with different abrasives
ISO 8501-1	1988(E)	Preparation of steel substrates before application of paints and related products-visual assessment of surface cleanliness ; Part 1 – rust grade and preparation grades of uncoated steel substrates after overall removal of previous painting



Annexure-1 (cont'd)

Standard No.	Year of Publication (reaffirm)	Title
ISO 8501-1 Supplement	1994	Representative photographic examples of appearance imparted to steel when blast-cleaned with different abrasives
ASTM B 117	1997	Standard practice for operating salt spray (fog) apparatus
SSPC-Vis1	1989	Description of visual standards
SSPC-Vis2	1982	Rust protection manual
SSPC-SP-1	1995	Solvent cleaning
SSPC-SP-2	1995	Hand tool cleaning
SSPC-SP-3	1995	Power tool cleaning
SSPC-SP-4	1995	Flame cleaning of new steel
SSPC-SP-5/NACE1	1995	White metal blast cleaning
SSPC-SP-6/NACE3	1995	Commercial blast cleaning
SSPC-SP-7/NACE4	1995	Brush off blast cleaning
SSPC-SP-8	1995	Pickling
SSPC-SP-10/NACE2	1995	Near white blast cleaning
SSPC-PA-1		Shop, field and maintenance painting
SIS 055900	1988	Pictorial surface preparation standard for painting of steel
DIN 55928-4/Supply	11991	Corrosion protection of steel structures by application of organic or metallic coating; preparation and testing of surfaces; representative photographic examination
IPSS:1-07-064-03		Code of Practice for Painting in Steel Plants



ANNEXURE-2

EQUIVALENT STANDARDS OF SURFACE PREPARATION GRADE

	Pictorial Representation of Swedish Std. SIS 055900	DIN Std DIN 55928 (Part 4).	SSPC Std.	BS Std. BS:4232	IS Std. (IS1477) (Part-1)
1 Blast cleaning to white metal: Removal of all visible rusts, mill scales, paint and foreign matters	Sa 3	Sa 3	SSPC-SP-5	1st qlty	CI A1.2
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 ^{1/2}	Sa 2 ^{1/2}	SSPC-SP-10	2nd qlty	CI A1.2
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	3rd qlty	CI L1.3
4 Brush-off blast cleaning: Removal of all loose mill-scales, rust and foreign matters etc	Sa 1	Sa 1	SSPC-SP-7	-	CI A1.4
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	-	CI 6.2.1.1



ANNEXURE-3

PAINTING SYSTEM

SL. No.	Description	Nature of exposure	Treatment in the shop				Treatment at site				Total DFT in microns (shop & site)
			Surface quality	No.of coats	DFT/coat in microns	Paint system	Surface quality	No.of coats	DFT/coat in microns	Paint system	
1	General service painting	Normal atmospheric environment non-corrosive atmosphere									
1(i)	Structural steelwork for plant and shop building (excluding areas defined in Annex-4 here-of), non-load bearing structural steelwork such as partitions, minor platforms, walkways, ring ladders pipe/cable support brackets etc. Location-all indoor temperature less than 80 deg C.		St 2 (Hand tool/Power tool cleaning)	1P	50	Alkyd based zinc phosphate anticorrosive primer	Clean and retouch	1 F	30	Synthetic enamel alkyd resin based paint	135
1(ii)	Steel doors, windows etc. of regular handling		Sa 2.5 (Abrasive blasting - grit blasting/copper slag blasting)	1P	70	Two component epoxy zinc phosphate anticorrosive primer	Clean and retouch	1 F	60-75	Two component polyurethane	230-245
2	Wearing surface painting										
	Painting of floor plates, walkways, staircase treads handrailing etc. which are prone to mild abrasion	Light corrosive atmosphere									

Annexure-3 (cont'd)

2

Annexure-3 (cont'd)

[illegible]

Annexure-3 (cont'd)

[illegible]

Annexure-3 (cont'd)

	- Non-insulated: temperature less than 80° C	Light corrosive	Sa 2.5 (Abrasive blasting - grit blasting/copper slag blasting)	1 P	15-25	Weldable epoxy based shop primer (optional)	Clean and retouch	1 F (optional)	25-30	Chlorinated rubber paint with weather resisting pigments of glossy finish	190-220 (excluding weldable primer)
				1 P	70-80	PVC-copolymer-alkyd resin-zinc phosphate					
				1 I	70-80	PVC-copolymer alkyd resin with MIO					
				2 F	25-30	Chlorinated rubber paint with weather resisting pigments of glossy finish					
	- Temperature 80° - 150° C		Sa 2.5 (Abrasive blasting - grit blasting/copper slag blasting)	1 P	70-80	Two component solvent based inorganic zinc rich ethyl silicate based primer					
				1 F	60-70	High build epoxy polyamide enamel	Clean and retouch	1 F (optional)	60-70	High build up epoxy polyamide enamel	130-150
			Sa 2.5(Abrasive blasting - grit blasting/copper slag blasting)	1 P	70-80	Two component solvent based inorganic zinc rich ethyl silicate based primer					
	- Temperature over 150° C						Clean and retouch				120-130
				2 P	25	Silicon - aluminium					

Annexure-3 (cont'd)

[illegible]

Annexure-3 (cont'd)

					Sa 2.5(Abrasive blasting - grit blasting/copper slag blasting)	1 P		60-70	Two component solvent based inorganic zinc rich ethyl silicate based primer	Clean and retouch	2 F	25	Silicon - aluminium	110-120
	- Indoor and outdoor temperature more than 150° C													
	Insulated pipework :													
	- Indoor and outdoor temperature less than 80° C				Sa 2.5(Abrasive blasting - grit blasting/copper slag blasting)	1P		60-80	Two component epoxy zinc phosphate anticorrosive primer	Clean and retouch	-	-	No finish coat	60-80
	- Indoor and outdoor temperature over 80° C				Clean	1 P		40-60	Corrosion protective wax/grease					40-60
4	<u>Extreme corrosive service painting</u>													
		Strongly corrosive atmosphere due to presence of												
		inorganic and organic acids,												
		alkalis, salts,												
		corrosive vapours and fumes etc.												
4(i)	Equipment such as process, vessels, pumps etc. and its associated structure in handling and treatment area, neutralising area etc. where acids/ alkalis/miscellaneous chemicals are handled	Extreme corrosive			Sa 2.5(Abrasive blasting - grit blasting/copper slag blasting)	1 P		15-20	Zinc phosphate - weldable epoxy primer (optional)	Clean and retouch				220-250 (weldable primer coat excluded)
						1P		60-75	Two component solvent based inorganic zinc rich ethyl silicate based primer					
	Temperature below 150° C					1 I		100	Two component: high					

Annexure-3 (cont'd)

[illegible]

Annexure-3 (cont'd)

[illegible]

[illegible]



ANNEXURE-4

SPECIAL AREA PAINTING

SCOPE

This covers areas requiring special attention. This also defines the painting systems found to be effective, and are to be adopted. These systems are briefly described below.

Sl. No.	Area covered	Painting system
1.0	Blast Furnace	
1.1	Pouring building except +1.9 m platform structure	Hand tool cleaning to St2 grade, and 3 coats of HR aluminium paint for 400°C
1.2	Structures below 1.9 m platform in pouring area	Blast cleaning to Sa2 grade, one coat ethyl zinc silicate primer and one coat air drying silicone aluminium paint
1.3	Structures of inclined gallery	Blast cleaning to Sa2 grade, one coat ethyl zinc silicate primer and two coats air drying silicone aluminium paint
1.4	Structure of distribution areas below +6 m	Blast cleaning to Sa2 grade, one coat ethyl zinc silicate primer and two coats air drying silicone aluminium paint
1.5	Structures of exhaust area & distribution area above +6 m	Blast cleaning to Sa2 grade, two coats of epoxy coal tar paint for total DFT of 200 microns
1.6	Roof sheeting of exhaust area	Etch primer, two coats of epoxy coal tar paint for total DFT of 200 microns
1.7	Hot metal ladle repair & torpedo ladle repair station Roof sheeting	HR aluminium paint 400°C
1.8	Heating station structure & roof sheeting	HR aluminium paint 400°C



Annexure-4 (cont'd)

Sl. No.	Area covered	Painting system
1.9	Junction houses of slag conveyors	Blast cleaning to Sa2 grade, two coats of epoxy coal tar paint for total DFT of 200 microns
1.10	Slag granulation plant roof & chimney structures	Blast cleaning to Sa2 grade, two coats of epoxy based primer and two coats of epoxy based enamel finish paint for total DFT of 125 microns
1.11	GCP area in BF throttle structures	Blast cleaning to Sa2 grade, two coats of chlorrubber based primer and two coats of chlorrubber based finish paint for total DFT of 125 microns
1.12	CO gas flare stack	Blast cleaning to Sa2 grade, two coats of chlorrubber based primer and two coats of chlorrubber based finish paint for total DFT of 125 microns
2.0	Steelmelt Shop	
2.1	Steel & slag transfer car track roof structure & CGI sheets	Hand tool cleaning to ST2 grade, HR aluminium paint 600°C
2.2	Heat shield over all machines in CCD & over L.D. in converter, ladle furnace	Hand tool cleaning to ST2 grade, HR aluminium paint 600°C
3.0	Flood Light Towers	Blast cleaning to Sa2 grade, two coats of chlorrubber based primer and two coats of chlorrubber based finish paint for total DFT of 125 microns



ANNEXURE-5

COLOUR CODE

Shades of finish coat of paint applied over respective item are as under:

Items painted	Colour	Colour No. of IS:5	Equivalent Munsell Value
1.	Structures		
Building frames Including bracings, Side girts, louvres, etc.	Aircraft grey	693	9.5BG 5.0/0.7
Crane girders	Azure blue	104	3.9B 4/3.4
Crane stops	Post office red	538	8.7R 3.0/13.2
Monorail with maintenance walkway	Post office red	538	8.7R 3.0/13.2
Gutters	Black bituminous Aluminium	-	-
Fire escape platforms, ladders etc.	Signal red	537	8.7R 3.8/15.5
Vertical posts of handrailing	Black	-	-
General hand railing, top runners	Lemon yellow	355	3.2Y 7.6/11
Rung ladders	Lemon yellow	355	3.2Y 7.6/11
All members blocking passages for movement	Lemon yellow	355	3.2Y 7.6/11



Annexure-5 (cont'd)

Items painted	Colour	Colour No. of IS:5	Equivalent Munsell Value
Trestles, towers and pipebridges	Dark admiralty grey	632	8.2B 3.9/1.0
Conveyor gallery structures	Aircraft grey	693	9.5BG 5.0/0.7
Steel chimneys	Aluminium	-	-
2.	Equipment and machinery		
General indoor equipment	Light grey	631	3.5G 5.8/1.1
General outdoor equipment	Dark admiralty grey	632	8.2B 3.9/1.0
Hoppers, chutes and bin structure (except supporting beams)	Post office red	538	8.7R 3.0/13.2
Crane bridges, trolleys, hooks etc and other mobile equipment	Base: Lemon yellow Stripes: Black (100 mm wide)	355 -	3.2Y 7.6/11 -
Furnaces	Aluminium	-	-
Tanks	Base: Same as for general equipment Stripes: Same shade As for piping around The tank at half the Tank height		
Fire-fighting Equipment	Signal red	537	8.7R 3.8/15.5



Annexure-5 (cont'd)

Pipework:

Colours shall be as given below. The base colour shall be applied throughout entire length except, on surfaces if materials such as asbestos, aluminium, brass, bronze, galvanised 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 type of suitable material or label attached to the pipework. Additional identification bands superimposed over the base colour shall be provided near each branch, valve and at 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 directions:

Service	Colour	Colour No. of IS:5
Condensate (Pressure)	Base aluminum cladding first band brilliant green	221
	Second Band canary yellow	309
Condensate (gravity)	Base aluminum cladding first band brilliant green	221
	Second Band signal red	537
Drinking water	Base brilliant green	221
	First band French blue	166
	Second band signal red	537
Makeup water boosting per 5Kg/cm ²	Base brilliant green	221
	First band French blue	537
Raw water (with boosting)	Base brilliant green	221
	First band signal red	537
	Second band black	
Sludge water a)Pressure	Base black	
	First band red oxide	446
b)Gravity	Base black	
	First band red oxide	446
	Second band black	
Local re-circulating of Industrial water (supply),Clean	Base brilliant green	221



Annexure-5 (cont'd)

Service	Colour	Colour No. of IS:5
Local re-circulating of Industrial water(supply), Contaminated	Base brilliant green	221
	First band black	..
	Second band signal red	537
Local re-circulating of Industrial water(supply), Clean pressure	Base black	221
	Band brilliant green	
Local re-circulating of Industrial water(supply), Clean gravity	Base black	
Local re-circulating of Industrial water(supply), Contaminated pressure	Base black	
	First band brilliant green	221
	Second band signal red	537
Return hot water of recirculating cycle of metal conditioning unit:		
a) Pressure	Base black	
	First band signal red	
b) Gravity	Base black	
	First band signal red	
	Second band signal red	
Fire fighting water	Base brilliant green	221
	First band French blue	166
	Second band signal red	537
Industrial waste water		
a) Pressure	Base sea green	217
b) Gravity	Base sea green	217
	First band light brown	410
Chilled water		
a) supply	Base aluminum cladding	
	First band brilliant green	221



Annexure-5 (cont'd)

Service	Colour	Colour No. of IS:5
b)return	Second band French blue Base aluminum First band brillent green cladding Second band French blue Third band black	166 221 166
DM Water or feed water a)With insulation, pressure = 10 kscg	Base aluminum cladding First band brillent green Second band French blue	 221 221
Soft cold water (supply)	Base deep orange First band brillent green	591 221
Soft hot water (supply)	Base deep orange First band brillent green Second band French blue	591 221 221
Compressed air	Base sky blue Band white	101
Instrument air	Base sky blue First band white Second band white	101
Fuel Oil (insulated)	Base aluminum cladding Band sky blue	101
Coke Oven gas (Low pressure, up to 1 Kscg)	Base canary yellow	309
Coke Oven gas (high pressure 6 Kscg)	Base canary yellow Band signal red	309 537
BF Gas	Base red oxide	446
BF Gas (contaminated)	Base red oxide Band black	446



Annexure-5 (cont'd)

Service	Colour	Colour No. of IS:5
BF Gas (semi cleaned)	Base red oxide First band black Second band black	446
LD Gas	Base red oxide Base canary yellow Second band canary yellow	446 309 309
Mixed gas	Base red oxide Base canary yellow	446 309
LP Gas (line code 82)	Base dark violet Firstband brilliant green Second band black	221
Nitrogen (line code 26 (40)	Base canary yellow	309
	Band black	
Nitrogen (line code 26 (10)	Base canary yellow First band black Second band black	309
Oxygen 99.5%	Base Azure blue First band canary yellow Second band signal red	104 309 537
Oxygen general purpose	Base Azure blue First band canary yellow Second band signal red	104 309 537
Steam low pressure 31(3)	Base aluminum cladding First band canary yellow Second band black Third band golden brown	309 414



Annexure-5 (cont'd)

Service	Colour	Colour No. of IS:5
Steam low pressure 31(7)	Base aluminum cladding First band canary yellow Second band black	309
Steam medium pressure -31(47)	Base aluminum cladding First band silver grey	628
Steam medium pressure -31(40)	Base aluminum cladding First band silver grey Second band black	628
Steam high pressure 31(103)	Base aluminum cladding First band canary yellow	309
Hydrogen	Base canary yellow First band signal red Second band French blue	309 537 166
Cold blast main	Base aluminium First band signal red	537
Hot blast main	Base aluminum First band signal red Second band canary yellow	537 309
Pneumatic transport pipelines	Base white First band post office red	538
Acidic and alkali sewage (pressure)	Base black Band brilliant green	221
Acidic and alkali sewage (gravity)	Base black Band brilliant green Second band brilliant green	221 221



Annexure-5 (cont'd)

Service	Colour	Colour No. of IS:5
Acidic and alkali sewage (pressure)	Base black	
	Band brilliant green	221
Acidic and alkali sewage (gravity)	Base black	
	Band brilliant green	221
	Second band brilliant green	221