INTERPLANT STANDARD - STEEL INDUSTRY		
सेल SAIL A Maharatna Company IPSS	**CODE OF PRACTICE FOR PAINTING IN STEEL PLANT**	**IPSS:1-07-064-03**
	Corresponding Indian Standard does not exist	

0. FOREWORD

0.1 This Inter Plant Standard has been prepared by the Standards Committee on Paints & Portable Maintenance Equipment, IPSS 1:7, with the active participation of the representatives of all the steel plants and established manufacturers and painter specializing in painting of steel surfaces, and was adopted in January 2003.

0.2 Inter Plant Standardization for steel industry primarily aims at achieving rationalisation and unification of parts, sub-assemblies, items & consumables used in steel plant equipment and accessories, and provides guidance in indenting stores for existing equipment (or while placing orders for additional requirements) by individual steel plants. For exercising effective control on the inventories, it is advisable to select a fewer number of sizes (or types) of products mentioned in this document, in the form of Company Standard of individual steel plants; it is not desirable to make deviation in technical requirements.

0.3 It has been observed that nearly seventy percent of steel structurals are damaged due to corrosion. Corrosion results in loss of assets, higher maintenance cost and additional risk to human lives. For corrosion mapping the steel plant has been categorised into different zones depending on intensity of corrosion. Much emphasis has been given on surface preparation which is considered as the essence of painting. The provisions of Swedish codes have been adopted for surface preparation which is the world wide practice. The primers, intermediates and finish coats of a wide range of paints have been specified to help the executing agencies in identifying the required coating systems, speed sheets have been provided as a ready reference to select an appropriate painting scheme for a specified area.

1. SCOPE

1.1 This Inter Plant Standard contains the Painting Schedule covering the materials, tools, facilities and quality requirements for surface preparation and painting of various structures and equipments in existing and new units. The term painting referred hereafter will cover rust preventive, corrosion preventive, fungs / insect preventive, decorative, organic/inorganic, metalic coating and surface protection for the following :

a) Structural steel work including building frames, technological structures and claddings for these, surfaces of floor plates, walkways etc., steel doors, window, rolling shutters, etc. in existing and new units.

b) Various types of static and rotary equipment including electric motors, crane structures, panels and control desks.

c) Steel tanks, vessels, bins, bunkers, stacks, etc.
d) Pipe lines and ducts with bridges, trestles, hangers etc, to support them.
e) RCC and PCC structures including building frames, bins, bunker bridges etc.
f) All kinds of masonry works.

ENVIRONMENT:

For the purpose of painting the plant has been divided in five broad categories according to the level of corrosive environment prevailing in such areas :

i) Normal (negligible corrosion) (N) less than 1 mil/year
ii) Nominal corrosive area (NC) 1 mil/year
iii) Moderately corrosive area (MC) 1 to 3 mils/year
iv) Severely corrosive area (SC) more than 5 mils/year
v) Hot, Hot and corrosive area (HC) 5 mils/hr.

(1 mil = 1/1000 of an inch)

2. SURFACE PREPARATION

Significance of surface preparation – corrosion is an electrochemical phonemon. Therefore, most of the primers are designed to behave electrochemically at the surface such as by providing a passive layer at the surface & cathodic protection. Any obstruction in the form of rust, grease, or old paints will affect the electrochemical link of pigments at the surface. Therefore, performance of painting system depends greatly on the surface cleaning.

2.1 VARIOUS FACTORS AFFECTING THE SURFACE

2.1.1 EFFECT OF MILL SCALE : Generally the steel plates for structural steel work or industrial use are manufactured by hot rolling during which the surface is oxidised rapidly and forms a layer of iron oxide which is called “mill scale”. The thickness of mill scale varies from 0.2 to 2.5 mils of an inch). Mill scale has a laminated structure and consists of three layers of iron oxide in different forms. The first layer next to the substrate is Ferrous oxide (FeO). The middle layer is Ferrous Ferric Oxide (Fe_3O_4) and the final exposed layer is Ferric oxide (Fe_2O_3). An uniform and perfectly intact mill scale would provide an effective defensive barrier against corrosion. From the commercial point of view, it is not a practical proposition, because to achieve the desired result of painting over undamaged mill scale, it shall be done at the rolling mill before the steel has the left the rolls.

2.1.2 EFFECT OF RUST : Besides mill scale, a steel substrate also get rusted due to `natural’ corrosion by electrochemical cell formation. Rust is highly detrimental because iron gives rise to four times its volume of rust. Rust is essentially the conversion of metal iron into a hydrated form of its oxide, $Fe_2O_3. 6H_2O$. If a substrate is not free from mill scale or rust, accelerated rusting of base metal can occur through electrolytic action between the mill scale or rust and steel. The mill scale, or rust is cathodic to steel. The potential difference between mill scale or rust and steel is about 0.3V. This electrochemical action would corrode the steel further. It is also liable to spill and carry away the paint film. Hence before application, the substrate shall be free from mill scale or rust.

2.1.3 EFFECT OF GREASE OIL, DUST ETC. : Before application of paints, the surface shall

be free from any grease, oil, dust or loose particles. Poor adhesion results when paint is applied to a substrate containing the above. If the coating has poor adhesion to the surface, it will permit oxygen and moisture penetrating through the film and will initiate corrosion. Oil or grease present on the surface can also retard drying of paints. Immediately before painting, all loose materials shall be cleaned from the surface by dusting, brushing or washing down. Surface containing oil or grease shall be cleaned with solvent or by means of steam jet.

2.1.4 EFFECT OF MOISTURE : Whatever my be the protective value of the paint when it is applied on a surface containing condensed moisture, serious corrosion may occur under the paint film. The corrosion in this case is by electro-chemical process which is represented below by a simplified overall reaction :

$4Fe + 6H_2O + 6O_2 = 2Fe_2O_3.\ 6H_2O$ (RUST)

Therefore before painting, the surface shall be dry.

2.1.5 EFFECT OF ACID OR ALKALI : Acids or alkali remaining on the surface will accelerate corrosion reaction underneath. This generally happens when a surface is improperly treated with acid pickling or alkali cleaning or when the atmosphere is acidic or alkaline.

2.1.6 EFFECT OF WELDING : If the welding is not carried out correctly, it can cause corrosion of the surface. The runs of welding are rough, making it difficult to ensure adequate and complete cover by paints. Oxidation caused by the welding process is detrimental to the performance of the paint film applied to the welded plate. The runs of welding shall be carefully removed from the surface by mechanical or abrasive cleaning or by any other suitable method.

2.2 SURFACE PREPARATION METHODS

2.2.1 BLAST CLEANING : Blast cleaning is the ideal surface preparation method to achieve an ideal surface for painting. All the other forms of surface preparation have their limitations. In blast cleaning, an abrasive is directed at high velocity against the surface. The abrasives are generally iron or steel shots / grits or coarse sand. There are three recognised specifications for blast cleaning standards and all give three equivalent grades.

<u>BLAST GRADE SPECIFICATIONS :</u>

a)	British standard BS 4232:1967	First Quality	Second Quality	Third Quality
b)	Steel structures painting council (USA) (SPCC Spec.)	White metal (SP-5-63)	Near white (SP-10-63)	Commercial (SP-6-63)
c)	Swedish standard* organization (SIS-05-5900-1985	Sa-3	Sa-2 ½	Sa-2
	* Swedish standards are universally accepted.			

BLASTING GRADE RECOMMENDATION GUIDES

Swedish standard	Corrosive Environment	Application
Sa-3	Extremely aggresive	When long term protection is desired because of difficult access to surface.
Sa-2 ½	Fairly corrosive	When long term protection is desired for chemically resistant systems such as polyurethane, epoxy and ohlororubber resin paints.
Sa-2	Mildly corrosive	For steel to be painted with an ordinary synthetic conventional system

The Swedish standard contains photographs of the various standards of three different degrees of blasted steel and is preferred for reference purpose by most individuals. While the Swedish standard is pictorial, the other two are descriptive, attempting to define the areas of residual scale etc. allowable for each grade. The Swedish standards, which are the most universally accepted, illustrate steel in four conditions before blasting has been carried out, as this will obviously affect the visual appearance of the surface after the required preparation. These are :

a) A completely mill scale covered uncorroded surface.

b) A surface which has begun to rust with mill scale present.

c) A surface which is fully corroded but not visibly pitted.

d) A surface which is severely corroded with obvious pitting.

The grades of cleaning by blasting are prefixed by the reference Sa, thus Sa-3 is steel blasted to white metal with all rust, mill scale etc. being removed fully. This is quite difficult to achieve practically and is normally specified for certain speciality coatings. Sa-2 ½, second quality or near white is the more usually accepted standard and would be considered as a suitable base to realise the full expected service of most coating systems. Anything less than this shall be a compromise. Brush off or sweep blasting is frequently used as a more rapid and probably cheaper method of removing firmly adhering and broken coating systems.

SURFACE PROFILE : Blast cleaning produces a roughened surface and the evenness of this profile is important. Most specifications call for peak to trough amplitudes of 100 microns maximum.

Abrasive	Max. Abrasive particle size (mesh)	Max. Height of Profile (mills)
Sand		
Very fine	80	1.5
Fine	40	1.9
Medium	18	2.5

Coarse	12	3.0
Crushed Iron Grit		
G-50	25	3.3
G-40	18	3.6
G-25	16	4.0
G-16	12	8.0
Iron Shot		
S-230	18	3.0
S-330	16	3.3
S-390	14	3.6

2.2.2 MANUAL CLEANING : Swedish standard SIS-05-5900:1985 lays down standard such as St-2 and St-3 and these are co-related to four initial rust grades A to D. In practice, standardization is difficult as results are related to operative performance. The traditional method of removal of mill scale on plates was to allow the plating to weather. This process loosens the mill scale which was then removed by scraping and wire brushing. This is an uncertain process as some mill scale is inevitably left on the surface. It is impossible to remove all rust or mill scale by this process. Although largly superceded by blast cleaning, this method is still used for :

a) Maintenance painting
b) Easily accessible steel work in rural / mild corrosive areas.
c) Steel work where conditions are non-corrosive
d) Steel work which is to be encased in brick work, concrete etc.
e) Internal surface of enclosed spaces that require painting.

The degree of cleanliness achieved is largely dependent upon the amount of weathering to which the steel has been subjected and the efforts of the operatives who have difficult in maintaining a constant satisfactory standard. There is only one recognised standard for manual cleaning operation and that is the Swedish standard SIS-05-5900:1985.

While this standard refers to the plates/structures that have been weathered for relatively short periods, and does not therefore show a great deal of pitting. It gives a fair indication of the type of surface preparation that can be achieved. Two standards are recognised St2 and St3.

St-1 : A lower standard St-1 was recognised in the 1960 edition. Of late this standard has been deleted. These are described as follows :

> "It is assumed that prior to treatment, the steel surface has been cleaned of dirt and grease and that the heavier layers of rust have been removed by chipping".

St-2 : Thorough scraping, emery cutting and wire brushing etc to be done manually. The treatment shall remove loose mill scales, rust and foreign matters. Finally, the surface is cleaned with a vacuum cleaner, clean dry compressed air or clean brush. It shall then have a faint metallic sheen. The appearance shall correspond to the prints designed for St-2.

St-3 : Very thorough scrapping, chipping, emery cutting and wire brushing etc. Surface

preparation same as for St-2 but much more thoroughly. After removal of dust, the surface shall have a pronounced metallic sheen and correspond to the prints designed for St-3. All inspectors shall study the photographs in the Swedish standard as they give a far better idea of the standards than any written description.

2.2.3 MECHANICAL CLEANING : Surface is cleaned by using pneumatic or electrical tools like power disc. sander, power driven wire brush, chippers and rotatory descalers etc. it is a better method than manual cleaning.

2.2.4 FLAME CLEANING : Oxy-acetylene flame is generally used to remove old paint and rust. Since the coefficient of expansion for steel and rust is different, on heating rust etc flakes off. This process is not in practice due to the chances of fire hazards and is expensive too. But this process is better than manual and mechanical cleaning but cannot be preferred to blast cleaning.

2.2.5 CHEMICAL CLEANING : Old paint can be removed by suitable paint cleaning solvent.

2.3 SURFACE PREPARATION FOR CONCRETE / MASONRY SURFACE

2.3.1 NEW CONCRETE SURFACE : The new concrete/masonry surfaces are very absorbent in nature, hence before painting proper curing of the surface shall be done. In case of smooth concrete surface light sand blasting would be ideal to provide key to paint. Alternately, acid etching with 10% hydrochloric acid can also be carried out. After acid etching surface shall be washed thoroughly with fresh water and surface shall be allowed to dry thoroughly, before application of paint. No anti-corrosive primer is generally necessary for concrete / masonry surface but a tack/tie coat of clean lacquer or thinned finish coat shall be applied before the final painting.

2.3.2 OLD CONCRETRE MASONRY SURFACE : Various surface contaminants like grease, oil, scales etc. shall be removed by using 10% Caustic solution. Thereafter, surface preparation procedure can be same as in case of new concrete / masonry surface.

3. PAINTING GUIDELINES

3.1 APPLICATION OF PAINT – The following precautions are suggested during paint application :

- Do not apply paint when temperature falls below 10 degree centigrade.
- Do not apply paint when humidity is above 80% or during fog, rain or mist.
- All the primers and finishes are to be supplied in brushing consistency. Thinner shall be added only if viscosity increases during the application due to higher ambient temperature. Normally, addition of thinner is restricted upto 5-10% by volume in case of brush application. In case of spray application only recommended thinner shall be used to bring the paints to spraying consistency.
- Blast cleaned surfaces shall be coated with primer within maximum 3-4 hours. If relative humidity is over 75%, this shall be reduced to 1-2 hours for better performance.
- All the two packed primers and paints shall be used up within the pot life

mentioned in data sheets.

· Application of paints are recommended at ambient temperature. The substrate shall also be at ambient temperature.

3.2 VOLUME SOLIDS – At a given dry film thickness, volume solid will govern the covering capacity of a paint. This is the volume of non-volatile matters which will form the paint film after application. The volume solid is related to theoritical covering capacity as per the following formula:

% volume solid = T.C.C x D.F.T / 10

T.C.C = Theoretical covering capacity (in sqm)

D.F.T = Dry film thickness (in microns)

3.2.1 THEORETICAL COVERING CAPACITY – The theoretical covering capacity at a given dry film thickness can be calculated from volume solids as per following formula :

T.C.C. = % volume solid x 10 / D.F.T (in microns)

3.2.2 PRACTICAL COVERING CAPACITY – The practical covering capacity depends on the losses which occurs during the paint application. Hence, theoretical covering capacity can not be achieved during the field application. These losses are due to the surface conditions, surface profile, shape of substrate, application procedure, poor skill of painters and weather conditions. Though there is no formula for calculating these losses but on the basis of actual observation a guideline is available.

3.3 LOSS FACTOR – As stated above, the following table indicates the estimated percentage losses. The losses may vary by $\pm$ 10 depending on the various circumstances such as nature of pitting, type of profile, wind direction and its intensity etc.

3.3.1 <u>GUIDELINE FOR LOSSES DURING APPLICATION OF PAINT :</u>

		BARE METAL/1ST COAT		COATED METAL /2ND COAT	
Type of surface application method		NEW Blast cleaned Sa 2.5	OLD Derusted St 3/Sa 2.5	NEW After the shop primer	OLD After the primer
PLATES	Airless spray	35	40	30	35
	Air spray	40	50	35	45
	Brush	30	40	25	40
ANGLE/ FLAT	Airless spray	45	55	45	55
	Air spray	50	60	50	60
	Brush	35	40	25	30
TUBULAR FRAME WORK	Airless spray	75	75	75	75
	Brush	30	35	20	30

4. METHODS OF APPLICATION

Proper application of protective coatings is an important criterion in giving the paint system

its required life. Given below are the four main application procedures along with the advantages and disadvantages of each.

4.1 BRUSH APPLICATION

Used frequently for decorative paints, and also in complex areas where the use of spray methods would increase the loss factor. However, a word of caution about brush application, it is difficult to achieve a high built by brush application in one coat. The process is relatively slow and may result in a poor finish for thixotropic or high viscosity top coats.

4.2 ROLLER APPLICATION

A popular method of decorative paints, it is sometimes also used for protective coatings. Though faster than brush application, it is not easy to control the paint film thickness by this method. Rollers of different lengths are available to suit varying surface roughness. They are not recommended for application of primers since it is difficult to ensure complete wetting of the surface especially when pitted.

4.3 CONVENTIONAL SPRAY

A widely accepted method of paint application where liquid paint is atomised by an air stream. A correct combination of air pressure air volume and fluid flow has to be selected to achieve full atomisation and a paint film free of defect. One may also face problems like sagging, pin-holing and poor paint flow if the control parameters are not monitored properly.

The major disadvantage of conventional spray is that high build coatings can not be applied by this method, as most paints have to be thinned to a suitable viscosity for satisfactory atomisation.

4.4 AIRLESS SPRAY

This is by far the fastest and most versatile method because it enables application at variable thicknesses. The equipment utilises on electric or air driven motor and a high pressure fluid pump to compress the coating to extreme pressures. The paint is then made to pass through a special tip which atomises it and controls the application properties.

The main advantanges of this method are :

a) High build coatings can be applied without thinning.

b) Very fast rate of application.

As already indicated, the special tips used in the spray gun and the pressure control enables one to monitor application of very low to very high viscosity products. Similarly, different slot angles produce spray fans of different widths. The selection of a particular fan width is dependent on the shape and size of the structure to be painted. The choice of fan width is also related to orifice size. For the same orifice size the paint applied per unit area will be less, wider the spray fan. The general indication of orifice sizes is given below to help in choosing the proper orifice size for a paint.

Wet Film Thickness	Orifice Size (mm)
Upto 50 microns	0.02-0.03
100-200 microns	0.03-0.04
> 200 microns	0.04-0.07
Mastics	0.10-0.15

There are several designs of tips available, the choice of which depends upon the finish required, the case of application and ease of cleaning blockages from tips.

5. PAINT MATERIAL

The paint systems specified herein and listed in Table 1 to 5 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 proprietory paint formulation, the performance of which has been tested in actual site conditions or under simulated conditions in test laboratory, the manufacturer's recommendations in all respects shall be adhered to.

The vehicle or the resin medium of the specified paint system for the respective paint product shall be chosen from the following and a compatible combination thereof as specified in Table 1 to 5 in order to provide a long lasting anti-corrosive protection of the surfaces.

5.1 PRIMER PAINTS (P) - Primer paints shall be applied only on dry and clean surface.

5.1.1 PRIMER PAINT P1 (Phenolic Alkyd based) - A single pack air drying phenolic modified alkyd composition with zinc phosphate as a primer paint conforming generally to IS 2074.

Air drying time	About one hour (touch dry) Overnight (hard dry)
Dry film thickness (DFT)/Coat	40 microns (min)
Temperature resistance	Upto 100^{o}C dry heat

5.1.2 PRIMER PAINT –P2 (Chlororubber based)

A single pack air drying high build chlorinated rubber based zinc phosphate primer.

Percent chlororubber	20 to 22% (chlorine above 65% in chlororubber)
Air drying time	About 15 minutes (touch dry) Overnight (hard dry)
Dry film thickness (DFT)/Coat	50 microns (min)
Temperature resistance	Upto 65^{o}C dry heat

5.1.3 PRIMER PAINT –P3 (PVC Copolymer alkyd based)

Polyvinyl chloride (PVC)	Alkyd zinc phosphateredoxide based primer
Ratio : PVC copolymer + alkyd resin (1:1)	
Pigments	Zinc phosphate & fillers
Air drying time	24 hours
Dry film thickness (DFT)/Coat	80 microns
Temperature resistance	Upto 80^{o}C dry heat

5.1.4 PRIMER PAINT –P4 (Epoxy based)

A two pack air drying Epoxy polyamide resin based redoxide zinc phosphate primer.

Epoxy content (% wt)	15 – 18
Air drying time	About 30 minutes (touch dry) Overnight (hard dry)
Dry film thickness (DFT)/Coat	30 microns (min)
Temperature resistance	Upto 120^{o}C dry heat

5.1.5 PRIMER PAINT –P5 (Epoxy based)

A two pack air drying Epoxy polyamide with zinc dust of at least 92% zinc dust on the dry film.

Epoxy content (% wt)	08 to 10
Air drying time	Less than 10 minutes (touch dry) Less than 2 hours (hard dry)
Dry film thickness (DFT)/Coat	40 microns (min)
Temperature resistance	Upto 300^{o}C dry heat

5.1.6 ETCH PRIMER –P6 (Poly-vinyl Butyral resin based)

A two pack air drying Epoxy polyvinyl butyral resin based wash primer with inhibitive pigments.

Air drying time	5 to 7 minutes (touch dry) 2 hours (hard dry)
Dry film thickness (DFT)/Coat	8 microns
Temperature resistance	Upto 65^{o}C dry heat

Applicable for	Galvanised iron, aluminium, light alloys etc., on which the adhesion of conventional paints are poor.

5.1.7 PRIMER PAINT–P7 (Ethyl zinc silicate, EZS based)

A two pack heavy duty zinc dust rich silicate primer which protects the surface with just a single coat.

Total solids (3 wt)	84 + 2
Density (gms/cc)	3.07 + 0.05
Air drying time	To top coat 16 hours
Dry film thickness (DFT)/Coat	60 microns
Temperature resistance	Upto 450^{o}C dry heat

5.1.8 PRIMER PAINT–P8 (High built coal tar Epoxy)

A two pack cold cured H.B. epoxy coal tar coating – no primer is required.

Mixing ratio	Base : Hardener (4:1 by vol)
Air drying time	Hard dy 48 hours full cure 7 days
Dry film thickness (DFT)/Coat	100 microns
Temperature resistance	Upto 450^{o}C dry heat

5.1.9 PRIMER PAINT–P9 (DINBOND M3M-AD)

Sl. NO	PRODUCT DETAILS	
1.	TYPE	A single pack one component self priming protective coating.
2.	COMPOSITION	Modified Vinyl Polymer binder.
3.	TEMPERATURE RESISTANCE	Upto 130^{o}C Higher serviceability offer in customized versions.
4.	POT LIFE	Unlimited.
5.	AIR DRYING TIME	Touch dry = 20 - 30 mins Hard dry = 1 – 1 ½ hr.
6.	DRY FILM THICKNESS PER COAT	30- 35 microns approx.
7.	COLOUR	Clear transparent.
8.	FINISH	Smooth, clear
9.	COMPATIBLE WITH	a) Primer - Yes b) Finish paint - Yes, except chlorinated rubber paints.

10.	THINNER/ CLEANER	DINBOND TH-2 in minor proportion only.
11.	SCOPE	For protection of steel structures hot rolled & cold rolled including G.I. & concrete/masonry exposed to strong mineral acid vapour attach, thermal oxidation, saline conditions, rain humidity etc and middly alkaline conditions. Excellent protection against sulfurous fumes sand/shot blasting not required of the substrate.

Sl. NO	PRODUCT DETAILS	
12.	USES AND METHODOLOGY	a) Concrete surfaces 1) New – Yes, Glass filled systems for acidspillage 2) Old – Yes, as in (1) including floors subjected to movement of persons & equipment. b) Structural steel 1) New structural steel – Yes 2) Old/prerusted steel having primer paint & on finish coat – Yes, except chlorinated rubber synthetic enamels (alkyd baded) c) G.I. Sheets – Yes d) Mild/Nominal corrosive area – Yes e) Severe corrosive area – Yes f) Whether applied in hot corrosive area – Yes.

5.1.10 PRIMER PAINT–P10 (POLY OXIDE)

S. NO	PRODUCT DETAILS	
1)	TYPE	A single pack one component self priming protective coating.
2)	COMPOSITION	Modified Vinyl Polymer binder.
3)	TEMPERATURE RESISTANCE	Upto 130^{o}C Higher serviceability offer in customized versions.
4)	POT LIFE	Unlimited.
5)	AIR DRYING TIME	Touch dry = 20 - 30 mins Hard dry = 1 – 1 ½ hr.
6)	DRY FILM THICKNESS PER COAT	35 microns approx.
7)	COLOUR	Grey, Black, Yellow, Green, Red, Oxide Red, P.C. Red & other sheet.
8)	FINISH	Matt.

9)	COMPATIBLE WITH	a) Primer - Yes b) Finish paint - Yes, except chlorinated rubber paints.
10)	THINNER/ CLEANER	DINBOND TH-2 in minor proportion only.

Sl. NO	PRODUCT DETAILS	
11)	SCOPE	For protection of steel structures hot rolled & cold rolled including G.I. & concrete/masonry exposed to strong mineral acid vapour attach, thermal oxidation, saline conditions, rain humidity etc and middly alkaline conditions. Excellent protection against sulfurous fumes sand/shot blasting not required of the substrate.
12)	USES AND METHODOLOGY	a) Concrete surfaces 3) New – Yes, Glass filled systems for acidspillage 4) Old – Yes, as in (1) including floors subjected to movement of persons & equipment. b) Structural steel 1) New structural steel – Yes 2) Old/prerusted steel having primer paint & on finish coat – Yes, except chlorinated rubber synthetic enamels (alkyd baded) c) G.I. Sheets – Yes d) Mild/Nominal corrosive area – Yes e) Severe corrosive area – Suggested as top coat with high inlet loading. f) Whether applied in hot corrosive area – Yes, as in (e).

5.1.11 PRIMER PAINT–PC1 (High built coal tar Epoxy)

A two pack, polyamide cured, non-shrinking, epoxy resin sealant.

Mixing ratio	Base : Catalyst = 1:1 (by volume)
DFT/Coat	Sufficient only to penetrate and seal the surface 30-35 microns.
Air drying time	Touch dry = 30-60 minutes Hard dry 16 hours
Over coating interval	2 hours (min.)
Colour	Clear
Finish	Glossy
Temperature resistance	93

Overcoat	High built enamel or coal tar epoxy.

5.2 INTERMEDIATE PAINTS (I)

These paints are formulated with micaceous iron oxide (NIO) and shall be applied over prime coat as an intermediate layer to provide weather proof seal of prime coat.

5.2.1 INTERMEDIATE PAINTS (I_1) (Phenolic alkyd based)

A single pack high built phenolic based paint with MIO.

Air drying time	4 to 6 hours (Touch dry) 2 days (Hard dry)
DFT/Coat	75 microns (min).
Temperature resistance	Upto 100^{o}C dry heat
Compatible with	Primer P1.

5.2.2 INTERMEDIATE PAINTS (I_2) (Chlororubber based)

A single pack air drying high built chloro based paint with MIO.

Air drying time	15 minutes (Touch dry) 24 hours (Hard dry)
DFT/Coat	70 microns (min).
Temperature resistance	Upto 65^{o}C dry heat
Compatible with	Primer P2, P3 & P4.

5.2.3 INTERMEDIATE PAINTS (I_3) (PVC alkyd based)

PVC Copolymer	Resin 1:1
Pigments	Micaceous iron oxide (MIO)
DFT/Coat	80 microns
Temperature resistance	Upto 80^{o}C dry heat
Compatible with	Primer P2 & P3.

5.2.4 INTERMEDIATE PAINTS (I_4)

A two pack air drying high build epoxy resin based paint with MIO.

Air drying time	6 to 8 hours (Touch dry) 7 days (full cure)
DFT/Coat	100 microns.
Temperature resistance	Upto 180^{o}C dry heat

Compatible with	Primer P4 & P5.

5.3 FINISH (TOP COAT) PAINTS (F)

Finish paint coats shall be applied over prime coats and intermediate coats after cleaning & touch up of primed surface.

5.3.1 FINISH PAINT –F1

A single pack air drying high gloss phenolic alkyd modified synthetic enamel paint suitably pigmented.

Air drying time	3 to 4 hours (Touch dry) 24 hours (hard dry)
DFT/Coat	25 microns (min).
Temperature resistance	Upto 100^{o}C dry heat
Compatible with	Primer P1, Intermediate I_1
Colour	Generally all shades

5.3.2 FINISH PAINT –F2

A single pack air drying polyurethane enamel of high gloss and hard finish suitably pigmented.

Air drying time	2 to 2 2 ½ hours (Touch dry) 6 hours (hard dry)
DFT/Coat	30 microns (min).
Temperature resistance	Upto 100^{o}C dry heat
Compatible with	Primer P1 & P8, Intermediate I_1
Colour	Generally all shades

5.3.3 FINISH PAINT –F3

A two pack air drying bituminous aluminium paint.

Air drying time	1 to 2 hours (Touch dry) 21 hours (hard dry)
DFT/Coat	25 microns (min).
Temperature resistance	Upto 100^{o}C dry heat
Compatible with	Primer P1 Intermediate I_1
Colour	Bright metallic

5.3.4 FINISH PAINT –F4

A ready mixed oil-alkyd based synthetic enamel paint of high gloss and hard wearing properties.

Air drying time	6 to 8 hours
Coverage	14 to 16 sq m/litre.
Temperature resistance	Upto 60^{o}C
Compatible with	P8
Colour	Generally all shades

5.3.5 FINISH PAINT –F5

A single pack air drying plasticised chlororubber paint suitably pigmented.

Air drying time	30 minutes (Touch dry) 24 hours (hard dry)
DFT/Coat	35 microns (min).
Temperature resistance	Upto 65^{o}C dry heat
Compatible with	Primer P2 & P1, Intermediate I_2 & I_3
Colour	Nearly all shades except few

5.3.6 FINISH PAINT –F6

A PVC – copolymer alkyd based enamel.

Density	1.17 ± 0.05
Total solids (1 wt)	55 ± 2
DFT/Coat	40 microns
Compatible with	P2 & P3

5.3.7 FINISH PAINT –F7

A two pack air drying epoxy polyamide enamel suitably pigmented.

Air drying time	2 to 3 hours (Touch dry) 7 days (full cure)
DFT/Coat	40 microns (min).
Temperature resistance	Upto 130^{o}C dry heat
Compatible with	Primer P4 & P5, Intermediate I_4
Colour	Generally all shades

5.3.8 FINISH PAINT –F8

A single pack synthetic rubber based aluminium paint.

Air drying time	2 hours (Touch dry) 24 hours (hard dry)
DFT/Coat	25 microns
Temperature resistance	Upto 200^{o}C dry heat
Compatible with	No Primer paint except primer P5 is applicable in case of non-ferrous substrate
Colour	Smooth aluminium

5.3.9 FINISH PAINT –F9

A single pack heat resistant silicon resin based paint with leafing aluminium / graphite powders.

Air drying time	3 to 4 hours (Touch dry) 24 hours (hard dry)
DFT/Coat	20 microns (min).
Temperature resistance	Upto 400^{o}C dry heat
Compatible with	No Primer paint except P7 is applicable, shall be applied on cleaned blast steel surface
Colour	Smooth aluminium

5.3.10 FINISH PAINT –F10

A heavy duty single pack air drying anti-corrosive black bituminous paint.

Air drying time	4 to 5 hours (Touch dry) 72 hours (hard dry)
DFT/Coat	100 microns
Temperature resistance	Upto 80^{o}C dry heat
Compatible with	Primer P1
Colour	Black

5.3.11 FINISH PAINT –F11

A heavy duty two pack (85:15 w/w) or single pack air heat cured aluminium paint based on silicon resin.

Air drying time	4 hours (Touch dry) 18 hours (hard dry) 24 hours (recoating time)
DFT/Coat	15 to 20 microns.
Temperature resistance	600^{o}C (max)
Compatible with	No Primer

Colour	Lustrous aluminium

5.3.12 FINISH PAINT –F12

Type – Reinforced, Bituminous for medium based paint.

Air drying time	2 hours (surface dry) Overnight (hard dry)
DFT/Coat	25 microns.
Compatible with	No Primer
Colour	Black

5.3.13 FINISH PAINT –F13

Type – single pack, air drying bituminous medium pigmented with graphite powder and other inert fillers.

Air drying time	2 hours (Touch dry) 24 hours (hard dry) 16 hours (recoating time) Heat cured at 100 ^{o}C for 6 hours after 24 hours of application.
DFT/Coat	30 microns.
Temperature resistance	100 ^{o}C - 540^{o}C
Compatible with	No Primer

5.3.14 FINISH PAINT –F14

Type – single pack, air drying unpigmented bituminous varnish.

Air drying time	4 hours (Touch dry) 16 hours (hard dry) 16 hours – overnight (recoating time)
DFT/Coat	30 microns.
Temperature resistance	230 ^{o}C
Compatible with	No Primer

5.3.15 FINISH PAINT –F15

Type – two pack, cold cured solventless epoxy resin, coal tar and other adhesive and pigments.

Air drying time	10 hours (Touch dry) 48 hours (hard dry) 24 hours (recoating time)
DFT/Coat	150-200 microns.

Temperature resistance	230 ^{o}C
Compatible with	Etch Primer for G.I./Aluminium sheets

5.3.16 FINISH PAINT–F-16 (DINBOND M3M)

SL. NO.	PRODUCT DETAILS	
1.	TYPE	A single pack one component self priming protective coating.
2.	COMPOSITION	Modified Vinyl Polymer binder with inert additives customized according to chemical environment.
3.	TEMPERATURE RESISTANCE	Upto 150^{o}C.
4.	POT LIFE	Unlimited.
5.	AIR DRYING TIME	Touch dry = 20 mins Hard dry = 1 – 1 ½ hrs.
6.	DRY FILM THICKNESS PER COAT	40 microns approx.
7.	COLOUR	Clear.
8.	FINISH	Clear.
9.	COMPATIBLE WITH	a) Primer - None, except base coat of Dinbond M3M – AD or Poly Oxide b) Finish paint - No.

Sl. NO	PRODUCT DETAILS	
10.	THINNER/ CLEANER	DINBOND TH-3 in minor proportion only.
11.	SCOPE	For protection of steel structures, concrete/masonry exposed to strong acidic/alkaline conditions together with abrasive conditions.

12.	USES AND METHODOLOGY	a) Concrete surfaces 1) New – Yes, 2) Old – Yes, especially recommended including floors subjected to movement of persons & equipment. b) Structural steel 1) New structural steel – Yes, with a basecoat of Dinbond M3M-AD 2) Old/prerusted steel having primer paint & on finish coat over it – No. c) G.I. Sheets – No d) Mild/Nominal corrosive area – Yes e) Severe corrosive area – Yes. f) Whether applied in hot corrosive area – Yes.

5.3.17 FINISH COAT –FC1

Anticorrosive polymer coating system based on epoxy / pnenolic based (interpenitrating polymer network developed by CBRI, Roorkee).

Base	Epoxy / phenolic
Mix proportion	Base : curing agent = 1:1
Curing	48 hours at 25^{o}C
Coverage	5-6 sq m/litre on smooth concrete surface
Colour	Red/Yellow/Brown
Compatible with	Epoxy sealant PC1

5.3.18 FINISH COAT –FC2

Catalyzed high build epoxy resin, two pack.

Air drying time	2 – 3 hours (Touch dry) 24 hours (hard dry)
Curing	7 days (min)
DFT/Coat	100-150 microns.
Temperature resistance	120^{o}C
Compatible with	No Primer / PC1
Colour	White / Grey

Paint manufacturer's test report or technical data sheet pertaining to the paint selected shall be obtained. The data sheet shall indicate among other things the relevant standards, if any, composition in weight percent of pigments, vehicles, additives, drying time, viscosity, spreading

rate, flash point, method of application, quality of surface preparation required, corrosion resistance properties and colour shades available.

6. MIXING AND THINNING AND STORAGE OF PAINT

All ingredients in a paint container shall be thoroughly mixed to breakup 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 undersirable matters.

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.

Additives that are received separately, such as, curing agents, catalysts, hardners 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.

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.

6.1 STORAGE OF PAINT

All paints shall be stored 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, preferably located in an isolated room or in a separate building.

All paint containers shall be clearly labelled to show at the time of use the paint identification, date of manufacture, batch number, order number and special instructions in legible form. The containers shall be opened only at the time of use. Paints which have 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 without inspection and approval by the Purchaser.

7. PAINT APPLICATION

General

Paint shall be applied in accordance with manufacturer's recommendations and as supplemented by this specification.

Paint shall generally be applied by brushing, except that spraying may be used for finish coats only when brushing may damage the prime coats. Roller coat or any other method of paint application shall not be used unless specifically authorised. Spraying shall not be adopted on red lead or zinc rich paints. Daubers may be used only when no other method

is practicable for proper application in difficult accessible areas.

Paint shall generally not be applied when the ambient temperature is 10^{o}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%; 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.

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 high as to affect detrimentally either the appearance or the service of the paint.

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 practicable, to produce contrast and help identify the progress of work.

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

7.1 BRUSH APPLICATION

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 generally exceed 125mm. 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 levelling the paint film with long ad 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.

7.2 SPRAY APPLICATION

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.

The paint shall be applied by holding the gun perpendicular to the surface, at a suitable distance and move 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.

7.3 SHOP PAINTING

All fabricated steel structures shall have a minimum of two primer coats prior to despatch

to site. The paint shall be applied immediately after surface preparation to the specified quality preferably within two hours.

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 two 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 of 2000 or solvent deposited compound to IS 1153:2000 or 1674:1990 or an international equivalent.

Surfaces to be in contact with concrete shall not be painted. Surfaces to be in contact with wood, brick or masonry shall be given one shop coat of the specified primer.

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 50mm 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.

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

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

7.4 SITE / FIELD PAINTING

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) 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.

If necessary, equipment and large machinery having full painting shall be given one finish coat compatible with shop coats after necessary cleaning and touch up.

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 completed and all cement and concrete spatters and drippings removed and damaged surfaces touched up before application of the finish coat.

If in the opinion of the purchaser, the damage to shop coat 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.

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.

All cracks and crevices shall be filled with compatible paint or putty. All fields 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.

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

7.5 MAINTENANCE PAINTING

In all maintenance painting, the aim is to repaint before the old paint has deteriorated to a stage where it has to be entirely removed. This is done by periodically applying a single new coat of paint over the cleaned old paint substrate. The ordinary length of such a period for a iron and steel complex set up in tropical industrial environment is around three to four years depending on the paint system initially adopted.

In maintenance painting it is ordinarily intended that sound, adherent old paint be removed unless it is excessively thick or brittle or is incompatible with the new paint. It is essential, however that the removal of deteriorated paint be carried back around edges of the spot or area until an area of completely intact and adherent paint film, with no rust or blisters underneath is attained. Edges of tightly adherent paint remaining around the area to be recoated must be feathered, so that the repainted surface can have smooth appearance. The remaining old paint shall have sufficient adhesion so that it cannot be lifted as a layer by inserting the blade of a dull putty knife under it. For defective areas of old paint substrate, spot clean to provide new anchoring profile and apply adequate number of coats of compatible primer over those areas to build them up to a satisfactory level. Then an overall finish coat is applied or two finish coats as it becomes necessary.

8. SAFETY MEASURE - For safety point of view the persons along with the supervisors who have to do painting, cleaning, short blasting etc as a normal practice prevailing in the plant must take safety induction from safety engineering department before starting the job. The supervisors must follow the safety induction instructions such as use of safety belt, helmet, goggles, apron, fuller mask etc while doing the job.

ENVIRONMENT
Categorization of various plant units according to the corrosive environments as defined on page no. 2

	Sl No	Department	Unit/Areas
Safety corro-sive area (area code SC)	1.	PCM & Desulphuri-sation	Common salt platforms.
	2.	Lime Dolomite Brick Plant	Limekiln area – all the bldgs., equipments, pipelines and allied structures.
	3.	Slag Granulation Plant	Granulating and storage bays - all buildings, equipments, pipelines and allied structures.
	4.	Coke Ovens	All structures, equipments, pipelines and allied structures in the vicinity of quenching towers on guide car side.
	5.	Coal Chemical	Sulphur storage shed, sulphuric acid plant, ammonium sulphate plant - all buildings, equipments, pipelines and allied structures in and around the above bldgs in site "C".
	6.	Rolling Mills	Acid handling plants, - all structures, equipments, pipelines and allied structures.
	7.	Power Plant	Water treatment plants, - all bldgs., equipments, pipelines and allied structures.

ENVIRONMENT

Categorization of various plant units according to the corrosive environments as defined on page no. 2

	Sl No	Department	Unit/Areas
Hot, Hot & corro-sive area (area code H, HC)	1.	Blast furnace	Metal and slag side platforms, splash guards, cast-house columns and girders, stoves & platforms, stacks etc.
	2.	Steel melting shop	LD converters, mixers, continuous caster and adjoining structures, dedusting chimney.
	3.	Coke Ovens	Guide cars, quenching cars, ram cars, charging cars, wharf battery and under ground heating systems.

	4.	Blooming & slabbing mills	Soaking pit chimneys, soaking pit, structurals with cover cars.
	5.	Power Plant	Chimneys for ID fans, dedusting chimney.
	6.	Hot strip Mill	Reheating furnace, equipments subjected to high temperature.
	7.	Cold rolling mill	Furnaces of annealing & galvanising lines and equipments subjected to high temperature.

ENVIRONMENT			
Categorization of various plant units according to the corrosive environments as defined on page no. 2			
	Sl No	**Department**	**Unit/Areas**
Mode-rately corro-sive area (area code MC)	1.	Blast furnace	Furnace platform, all pipelines with supporting structures, skip pit and skip car, cast house roof, main roof and platform.
	2.	BF auxiliary unit	Gas cleaning plant – all equipments & buildings, BF high lines, ladle repair shop, Pug Mill.
	3.	PCM & Desulphurisation	All structures and equipments except common salt platform in PCM.
	4.	Coke ovens	Conveyor galleries, deck plates, idler stand, trestles, grab cranes, screening house, service bunker roofs, pipelines and allied structures, slot bunkers' roof.
	5.	Sintering plant	Line plant building – equipments, pipelines and allied structures.
	6.	Rolling mills	Mill stand area, Reheating furnace area.
	7.	Power plant	Back pressure turnbine area, underground steel structures and equipments in underground of plot bunkers, boiler house roof, cooling towers (RCC & steel strl. And equipments), RCC chimneys for boiler and water treatment plant.
	8.	Gas pipelines and supports	The entire gas pipelines and supports.

ENVIRONMENT
Categorization of various plant units according to the corrosive environments as defined on page no. 2

	Sl No	Department	Unit/Areas
Nomi-nal corro-sive area (area code NC)	1.	Blast furnace	Pump house, workshop area, ladle repair shop and other structures not covered under any other four catagories.
	2.	Steel melting shop	General structures and equipments and pipelines with support except LD and mixer area.
	3.	SMS Auxiliary area	Scrap yard, ingot yard, stripper bays.
	4.	LDBP	Equipments, pipelines & area not covered under SC.
	5.	Slag granulation plant	Area not covered under SC.
	6.	Coke ovens	Other structures and equipments not covered under any other category.
	7.	Coal chemical Department.	Buildings, equipments, pipelines and bldgs. structures.
	8.	Sintering plant	Other structures not covered under MC.
	9.	Hot Mills	Other structures, equipments, etc not covered under any other category.
	10.	CRM	Other buildings, equipments, etc not covered under SC.
	11.	Water Management Department.	Bldg., equipments, pipelines and allied structures in DWS and TPH.
	12.	Power plant	Other bldgs., equipments pipelines and allied structures not covered under any other category.

ENVIRONMENT

Categorization of various plant units according to the corrosive environments as defined on page no. 2

	Sl No	Department	Unit/Areas
Nor-mal (Neglible corro-sive area) (area code N)	1.	Coal chemical Department.	Other structures, equipments etc. not covered under any other category.
	2.	Plate mill	Other structures, equipments, pipelines and allied structures not covered under MC.
	3.	Hot rolling mill	Other structures, equipments, pipelines and allied structures not covered under MC.
	4.	Cold rolling mill	Other areas, buildings, equipments, pipelines and allied structures not covered under SC.
	5.	Repair shops	Structures and equipments not covered under any other category.
	6.	Foundries	All buildings, equipments, pipelines and allied structures not covered under any other category.
	7.	Pipeline supports	Buildings, equipments, pipelines and allied structures not covered under any other category.

	8.	Roll shop	All RCC & steel structures.
	9.	Bridges & culverts	All RCC & steel structures.
	10.	Loco repair shops	All buildings, equipments, pipelines and allied structures.
	11.	Loco light shop & wagon maint. Shop	All buildings, equipments, pipelines and allied structures.
	12.	Mechanical shop	All buildings, equipments, pipelines and allied structures.

ENVIRONMENT			
Categorization of various plant units according to the corrosive environments as defined on page no. 2			
	Sl No	**Department**	**Unit/Areas**
Nor-mal (Neglible corro-sive area) (area code N)	13.	Special plate plant	All buildings, equipments, pipelines and allied structures.
	14.	Repair shops	All buildings, equipments, pipelines and allied structures.
	15.	Oil reclamation plant	All buildings, equipments, pipelines and allied structures.
	16.	Cable tunnels	RCC structures.
	17.	Central stores	PS-1 (RCC), PS-II (steel), Refractory stores (steel).
	18.	Pipeline supports	Other than covered under MC.
	19.	FM (M) Workshop, Fabrication shop, CCR work shop, Structural shop.	All structures.

COLOUR CODE

	ITEMS PAINTED	COLOUR	COLOUR NO. OF IS: 5-1994
STRUCTURES	Building frames	Aircraft grey	693
	Crane girders	Azure blue	104
	Crane stops	Post office red	538
	Gutters	Black bitumen aluminium	-
	Fire escape, platforms & ladders etc	Signal red	537
	General hand railing, Top runners	Lemon yellow	355
	Rung ladders	Lemon yellow	355
	All members blocking passage for movement	Lemon yellow	355
	Trestles, towers & pipe bridges	Dark admiralty grey	652
	Conveyor gallery structures	Aircraft grey	693
	Steel chimney	Aluminium	-
EQUIP-MENT AND MACHINERY	General indoor equipment	Light grey	631
	General outdoor equipment	Dark admiralty	632
	Crane bridges, trolleys, hooks etc & other mobile equipment	Base: Lemon yellow Strip: Black (100mm wide)	355
	Furnaces	Aluminium	-
	Tanks	Base: Light grey Strip: same shade as for pipling around the tank at half the tank height	631
	Fire fighting equipment	Signal red	537
ELE-CTR-ICAL EQUI-PME-NT	11 KV AC Machine	Light grey	631
	3.3 KV AC Machine	Post office red	538
	400 V AC Machine	Brilliant green	221
	400 V DC Machine	Azure blue	104
	250 V DC Machine	Oriental blue	174
	230 V AC Equipment	Light orange	557
	110 V AC Equipment	Canary yellow	309
	All indoor control and switchgear panels	Grey	697
	All outdoor transformers, switchgear, panels, etc.	Dark admiralty grey	632
	Instrumentation panels	Opaline green	275
	Telecommunication panels	Smoke grey	692

PIPE WORK:

Colours shall be as given below. The base colour shall be applied throughout entire

length except on surface of 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 distance not exceeding 10M 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 distance not exceeding 10M, the bands shall be at least 25mm wide except in case of double bands where the first band shall be about 100mm wide. Direction of flow shall be clearly marked on the pipe lines at intervals not exceeding 10M and at all branches and change of direction.

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ITEMS PAINTED	COLOUR	COLOUR NO. OF IS: 5-1994
Raw or river water (untreated)	Base : Sea green Band : White	217 -
Cooling water	Base : Sea green Band : French blue	217 166
Boiler feed water	Base : Sea green	217
Condensate	Base : Sea green Band : Light brown	217 410
Drinking water	Base : Sea green First Band : French blue Second band : Signal red	217 166 537
Industrial water	Base : Sea green Band : Light orange	217 557
Hydraulic power water	Base : Sea green Band : Black	217 -
Compressed air	Base : Sky blue	101
Instrument air	Base : Sky blue Band : Light brown	101 410
vacuum	Base : Sky blue Band : Black	101 -

Steam : (below 3.5 kg/sq cm)	Base : Silver grey if Bitulac or Al-jacket Band : Brilliant green	628 221
(between 3.5 kg/sq cm & 20 kg/sq cm)	Base : Silver grey if Bitulac or Al-jacket Band : French blue	628 166
(21 – 40 kg/sq cm)	Base : Al-jacket Band : Dark violet	- 796
(above 40 kg / sq cm)	Base : Al-jacket Band : Signal red	- 537
Drainage	Base : Black	-
Lubricating oil	Base : Light brown Band : Light grey	410 631
Hydraulic oil	Base : Light brown Band : Dark violet	410 796
Transformer oil	Base : Light brown Band : Light orange	410 557
Fuel oil	Base : Light brown Band : Signal red	410 537

ITEMS PAINTED	COLOUR	COLOUR NO. OF IS: 5-1994
Coke oven/coal gas/other fuel gases	Base : Canary yellow Band : Signal red	309 537
Freon (chlorofluore derivative of methane and ethane)	Base : Canary yellow Band : Light yellow	309 631
Argon	Base : Canary yellow Band : French blue	309 166
Acetylene	Base : Canary yellow Band : Dark violet	309 796
L.P.gas	Base : Canary yellow First Band : Signal red Second Band: Traffic green	309 537 267
Nitrogen	Base : Canary yellow	309
Oxygen	Base : Canary yellow Band : White	309 -
Regenerated acid (dilute) (1)	Base : Dark violet Band : Light brown	796 410
Hydrochloric acid (conc) (1)	Base : Dark violet First Band : Light brown Second band : Light brown	796 410 410

Spent liquor	Base : Dark violet First Band : Light Grey Second band : Light brown	796 631 410
Wash liquor	Base : Dark violet Band : Light grey	796 631
Dilute acidic liquors	Base : Dark violet First Band : Light grey Second band : Brilliant green	796 631 221
Hydrofluoric acid (conc) (1)	Base : Dark violet Band : Silver grey	796 628
Acidic slurries (1)	Base : Dark violet Band : White	796 -
Alkalis	Base : Dark violet Band : Deep buff	796 360
Non-acidic slurries	Base : Sea green Band : White	217 -
Fire fighting system	Base :Signal red	537

ITEMS PAINTED	COLOUR	COLOUR NO. OF IS: 5-1994
Rain water down pipes	Base : Sea green Band : Sky Blue	217 101
Duct work	Base : Aluminium	-
Lighting conduits	Base : Black Band : Yellow	- 309
Instrument conduits	Base : Black Band : Red	- 537
Power conduits	Base : Black	-

NOTE: (1) For these services, hazard marking as per Fig. 4C of IS:2379 shall also be provided.

NOTES:

1. The tables give an overall guideline for the structures/equipments etc. however, type and frequency etc. may be altered depending on specific location and equipment as per the consultant and owner.

2. All columns, rooflegs, trestles and pipe line supports up to +1m shall be painted with bituminous coating in nominal corrosive and normal areas.

3. All machined items of spare parts lying in open yard shall be given one coat of strippable paint (25 µ – 30 µ) by spray.

4. All foundations of new structures to be painted with two coats of bituminous black.

5. All repainting and maintenance painting is subjected to joint inspection report.

6. Necessary written clearances from authorised persons shall be obtained before starting the painting work at hazardous areas like gas lines, electrical connections high tension wires, acid lines, crane gantries, running equipments etc and at heights.

7. The name plates of the equipments like gear box, motors, panels, resistance boxes and controllers etc shall not be painted and shall be masked before applying the primer. Bolts & Nuts shall not be painted and shall be coated with strippable lacquer or similar paint.

8. The electrical conducting parts like power rails, power collectors, cross bars, slip rings, magnet drum, protective device and other parts like grease fittings, dualine valves, rope drum grooves etc. and parts specifically advised shall not be painted.

9. Paint shall generally be applied by brushing except when brushing may damage the primer coat.

10. Paint shall not be applied in rain, wind, fog, or at relative humidity of 80% and above or when the surface temperature is below 10 degree or rises above 50 degree.

11. Each coat of paint shall be continuous, free of pores and of even film thickness.

12. Each coat of paint shall be allowed to dry sufficiently before application of the next coat. Undercoats having glossy surface shall be roughened by mild sand papering to improve adhesion of subsequent coat.

13. Surface to be in contact with concrete shall not be painted. Surface to be in contact with wood, brick or other masonry shall be given one coat of specified primer.

14. The prime coat shall be applied as soon as possible after the surface preparation is complete.

15. Safety measures as stipulated in manufacturer's specification are to be followed.

GENERAL INSPECTION BEFORE & DURING PAINTING

1. Inspection of general appearance of finished works shall be as per IS 1477(part 1):2000.

2. DFT test shall be carried out with the help of Elcometer or equivalent standard thickness gauge. The thickness gauge is to be checked and tested as per standardised test bits supplied with the instruments before using.

3. Testing of paints shall be carried out as per IS 101 (Part 3/ sec 1):2001.

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