VOLUME - II PART - 2

SECTION – 7

STANDARD SPECIFICATION FOR SHOP AND FIELD PAINTING

Table of Contents

VOLUME -II
SECTION - 7

STANDARD SPECIFICATION FOR SHOP AND FIELD PAINTING

1.0.0 GENERAL

1.1.0 These technical specifications shall be applicable for the work covered by the contract, and without prejudice to the various codes of practice, standard specifications etc. It is understood that contractor shall complete the work in all respects with the best quality of materials and workmanship and in accordance with the best engineering practice and instructions of Engineer-in-charge.

1.2.0 Wherever it is stated in the specification that a specific material is to be supplied or a specific work is to be done, it shall be deemed that the same shall be supplied or carried out by the contractor.

Any deviation from this standard without written deviation permit from appropriate authority will result in rejection of job.

2.0.0 SCOPE

Scope of work covered in specification shall include but not limited to the following.

2.1.0 This specification defines the requirements for surface preparation, selection and application of paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, external & internal protection of storage tanks for all services.

2.2.0 Extent of works

2.2.1 The following surfaces and materials shall require shop, pre-erection and field painting:

a. All uninsulated equipment like pumps, valves, structural steel, vessels, storage tanks, pumps, compressors, electrical panels and motors etc.

b. All uninsulated carbon and low alloy piping fittings and valves (including painting of identification marks), furnace, ducts and stacks.

c. All items contained in a package unit as necessary.

d. All structural steel work, pipe, structural steel supports, walkways, handrails, ladders, platforms etc.

f. Identification colour bands on all piping as required including insulated aluminium clad, galvanised, SS and non-ferrous piping.

g. Identification lettering / numbering on all painted surfaces of equipment / piping insulated aluminium clad, galvanised, SS and non-ferrous piping.

h. Marking / identification signs on painted surfaces of equipment / piping

i. Supply of all primers, paints and all other materials required for painting.

j. Over insulation surface of equipments and pipes wherever required.

k. Painting under insulation for carbon steel and stainless steel as specified.

l. Repair work of damaged / protection / fabrication shop primer and weld joints at field.

2.2.2 The following surfaces and materials shall not be painted unless otherwise specified:

a. Uninsulated austenitic stainless steel.

b. Plastic and / or plastic-coated materials

c. Non-ferrous materials like aluminium, galvanised "piping", "gratings" and "Handrails" etc. except G.I towers.

2.3.0 Documents

2.3.1 The contractor shall perform the work in accordance with the following documents issued to him for execution of work.

a. Bill of quantities for Piping, equipment, machinery and structures etc.
b. Piping line list

c. Paining specification including special civil defence requirement.

2.4.0 Unless otherwise instructed final painting on pre-erection / shop primed pipes and equipments shall be painted in the field, only after mechanical completion and testing on system are completed, as well as, after completion of steam purging wherever required.

2.5.0 Changes and deviations required for any specific job due to clients requirements or otherwise shall be referred to EIL for deviation permit.

3.0.0 CODES & STANDARDS

3.1.0 Without prejudice to the provision of Clause 1.1 above and the detailed specifications of the contract, the following codes and standards shall be followed for the work covered by this contract.

IS: 5	:	Colour coding
IS: 101	:	Methods of test for ready mixed paints and enamels.
IS: 2379: 1990	:	Indian Standard for Pipeline identification colour code.
ASTM	:	American Standard test methods for paints and coatings.
ASA A 13.I- 1981	:	Scheme for Identification of piping systems: American National Standards Institution

3.2.0 Surface Preparation Standards

Following standards shall be followed for surface preparation:

3.2.1 Swedish Standard: SIS –05-5900-1967 / ISO – 8501-1-1988
(Surface – preparation Standards for painting steel surfaces).

This standard contains photographs of the various standards on four different degrees of rusted steel and as such is preferable for inspection purpose by the Engineer-in-charge.

3.2.2 Steel structures Painting council, U.S.A (Surface preparation specification (SSPC-SP).

3.2.3 British Standards (Surface finish or Blast cleaned for painting) BS: 4232.

3.2.4 National Association of Corrosion Engineers U.S.A (NACE)

3.2.5 Various International standards equivalent to Swedish standard for surface preparation are given in Table I.

3.3.0 The contractor shall arrange, at his own cost, to keep at set of latest edition of any one of the above standards and codes at site.

3.4.0 The paint manufacturer's instruction shall be followed as far as practicable at all times. Particular attention shall be paid to the following:

a. Instructions for storage to avoid exposure as well as extremes of temperature.

b. Surface preparation prior to painting.

c. Mixing and thinning

d. Application of paints and the recommended limit on time intervals between coats.

4.0.0 EQUIPMENT

4.1.0 All tools, brushes, rollers, spray guns, abrasive material, hand / power tools for cleaning and all equipments, scaffolding materials, shot / wet abrasive blasting, water blasting equipments & air compressors etc. required to be used shall be suitable for the work and all in the good order and shall be arranged by the contractor at site and in sufficient quantity.

4.2.0 Mechanical mixing shall be used for paint mixing operations in case of two pack systems except that the Engineer-in-Change may allow the hand mixing of small quantities at his discretion.

5.0.0 SURFACE PREPARATION, SHOP COAT, COATING APPLICATION & REPAIR AND DOCUMENTATION

5.1.0 General

5.1.1 In order to achieve the maximum durability, one or more of the following methods of surface preparation shall be followed, depending on condition of steel surface and as instructed by Engineer – in – charge. Adhesion of the paint film to surface depends largely on the degree of cleanliness of the metal surface. Proper surface preparation contributes more to the success of the paint protective system:

a. Manual or hand tool cleaning
b. Mechanical or power tool cleaning
c. Blast cleaning

5.1.2 Mill scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. The minimum acceptable standard in case of manual or hand tool cleaning shall be St.2 or equivalent, in case of mechanical or power tool cleaning it shall be St.3 or equivalent, in case of blast cleaning it shall be Sa2 ½ or equivalent as per Swedish standard SIS-055900-1967/ISO-8501-1-1988. Where highly corrosive conditions exist, then blast cleaning shall be Sa3 as per Swedish Standard.

Remove all other contaminants, oil, grease etc. by use of aromatic solvent prior to surface cleaning.

5.1.3 Blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceeding 85%.

5.1.4 Irrespective of the method of surface preparation, the first coat of primer must be applied on dry surface. This should be done immediately and in any case within 4 hours of cleaning of surface. However, at times of unfavourable weather conditions, the Engineer-in-Charge shall have the liberty to control the time period, at his sole discretion and / or to insist on recleaning, as may be required, before primer application is taken up. In general, during unfavourable weather conditions, blasting and painting shall be avoided as far as practicable.

5.2.0 Procedure of Surface Preparation

5.2.1 Blast Cleaning

5.2.1.1 Air Blast Cleaning

The surfaces shall be blast cleaned using one of the abrasives: Al_2O_3 particles chilled cast iron or malleable iron and steel at pressure of 7kg/cm^2 at appropriate distance and angle depending on nozzle size maintaining constant velocity and pressure. Chilled cast iron, malleable iron and steel shall be in the form of shot or grit of size not greater than 0.055" maximum in case of steel and malleable iron and 0.04" maximum in case of chilled iron. Compressed air shall be free from moisture and oil. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the materials for liners. Nozzles orifice may vary from 3/16" to 3 /4". On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust and must show a grey, white metallic lusture. Primer or first coat of paint shall be applied within 4 hours of surface preparation. Blast cleaning shall not be done outdoors in bade weather without adequate protection or when there is dew on the metal which is to be cleaned. Surface profile shall be uniform to provide good key to the paint adhesion (i.e. 35 to 50m). If possible vacuum collector shall be installed for collecting the abrasive and recycling.

5.2.1.2 Water Blast cleaning

Environmental, health and safety problems associated with abrasive blast cleaning limit the application of Air Blast cleaning in many installations. In such case water blast cleaning is resorted to.

Water Blast cleaning can be applied with or without abrasive and high-pressure water blasting. The water used shall be inhibited with sodium chromate / phosphate. The blast cleaned surface shall be washed thoroughly with detergents and wiped with solvent and dried with compressed Air. For effective cleaning abrasives are used. The most commonly used pressure for high pressure water blast cleaning for maintenance surface preparation is 3000 to 6000 psi at 35-45 litres / minute water volume and pressures up to 10000 psi and water volume of 45 litres / minute provide maximum cleaning.

The water blast cleaned surface shall be comparable to SSPC – SP – 12/NACE No.5. the operation shall be carried out as per SSPC guidelines for water blast cleaning. The indicative values for sand injection is

Air	:	300 to 400 Cu. ft/min
Water	:	5-10 litres / min. with corrosion inhibitor
Sand	:	200 – 400 lbs / hr

Nozzle : 0.5 to 1" dia

Special equipments for water blast cleaning with abrasives now available shall be used.

5.2.2 Mechanical or Power tool cleaning

Power tool cleaning shall be done by mechanical striking tools, chipping hammers, grinding wheels or rotating steel wire – brushes. Excessive burnish of surface shall be avoided as it can reduce paint adhesion. On completion of cleaning, the detached rust mill scale etc. shall be removed by clean rags and / or washed by water or steam and thoroughly dried with compressed air jet before application of paint.

5.2.3 Manual or hand tool cleaning

Manual or hand tool cleaning is used only where safety problems limit the application of other surface preparation procedure and hence does not appear in the specification of paint systems.
Hand tool cleaning normally / consists of the following:

a. Hand descaling and / or hammering

b. Hand scraping

c. Hand wire brushing

Rust, mill scale spatters, old coatings and other foreign matter, shall be removed by hammering, scrapping tools, emery paper cleaning, wire brushing or combination of the above methods. On completion of cleaning, loose material shall be removed from the surface by clean rags, and the surface shall be brushed, swept, dedusted and blown off with compressed air / steam to remove all loose matter. Finally, the surface may be washed with water and dried for effective cleaning.

5.3.0 Non compatible shop coat primer

The compatibility of finishing coat should be confirmed from the paint manufacturer. In the event of use of primer such as zinc Rich epoxy, inorganic zinc silicate etc. as shop coat, the paint system shall depend on condition of shop coat. If shop coat is in satisfactory

condition showing no major defects, the shop coat shall not be removed. The touch up primer and finishing coat (s) shall be identified for application by Engineer-in-charge.

5.4.0 Shop coated (coated with primer & finishing coat) equipment should no be repainted unless paint is damaged.

5.5.0 Shop primed equipment and surfaces will only be `spot cleaned' in damaged areas by means of power tool brush cleaning and then spot primed before applying one coat of field primer then shop coated primer should be completely removed before application of selected paint system for particular environment.

5.6.0 For packaged units / equipment, shop primer should be as per the paint system given in this specification. However, manufacturer's standard can be followed after review.

5.7.0 Coating Procedure and Application

5.7.1 The surface shall not be coated during rain, wind, or in environments containing harmful airborne elements, when the steel surface temperature is less than 5°F above the dew point, when the relative humidity exceeds 85%, or when the ambient temperature is below 40°F."

5.7.2 Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no cast later than 4 hours, the same day.

5.7.3 To the maximum extent practicable, each coat of material shall be applied as a continuous film uniform thickness free of probes. Any spots or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.

5.7.4 Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without the development of any determental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer instruction shall be followed for intercoat interval.

5.7.5 When the successive coat of same colour has been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate complete coverage of

the surface. The tinting material shall be compatible with the material and not detrimental to its service life.

5.7.6 Air spray application shall be in accordance with the following:

a. The equipment used shall be suitable for the intended purpose, shall be capable of properly atomising the paint to be applied, and shall be equipped with suitable pressure regulators and gauges. The air caps, nozzles, and needles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.

b. Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and must be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.

c. Ingredients shall be kept properly mixed in the spray pots or containers during application by continuous mechanical agitation.

d. The pressure on the material in the pot and of the air at the gun shall be adjusted for optimum spraying effectiveness. The pressure on the material in the pot shall be adjusted when necessary for changes in elevation of the gun above the pot. The atomising air pressure at the gun shall be high enough to properly atomize the paint but not so high as to cause excessive fogging of paint, excessive evaporation of solvent, or less by overspray.

e. Spray equipment shall be kept sufficiently clean so that dirt, dried paint, and other foreign materials are not deposited in the paint film.

   Any solvents left in the equipment shall be completely removed before applying pint to the surface being painted.

f. Paint shall be applied in a uniform layer, with overlapping at the edge of the spray pattern. The spray patters shall be adjusted so that the paint is deposited uniformly. During application, the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet layer of paint is deposited on the surface. The trigger of the gun should be released at the end of each stroke.

g. All runs and sags shall be brushed out immediately or the paint shall be removed and the surface repainted.

h. Areas inaccessible to the spray gun shall be painted by brush, if not accessible by brush, daubers or sheepskins shall be used.

i. All nameplates, manufacturer's identification tags, machined surfaces, instrument glass, finished flange faces, control valve items and similar items shall be masked to prohibit coating desposition. If these surfaces are coated, the component shall be cleaned and restored to its original condition.

j. Edges of structural shapes and irregular coated surfaces shall be coated first and an extra pass made later.

k. If spary gun shows choking, immediately dechoking procedure shall be followed.

5.7.7 Airless spray application shall be in accordance with the following procedure: as per steel structure paint manual Vol.1 & Vol.2 by SSPC, USA. Air less spray relies on hydraulic pressure rather than air atomization to produce the desired spray. An air compressor or electric motor is used to operate a pump to produce pressures of 1,000 to 6,000 psi. Paint is delivered to the spray gun at this pressure through a single hose within the gun, a single paint stream is divided into separate streams, which are forced through a small orifice resulting in atomization of paint without the use of air. This results in more rapid coverage with less overspray. Airless spray usually is faster, cleaner, more economical and easier to use than conventional air spray.

Airless spray equipment is mounted on wheels, and paint is aspirated in a hose that sucks paint from the container, including drums. The unit shall have inbuilt agitator that keep the paint uniformly mixed during the spraying. The unit shall consist of inbuilt strainer. Usually very small quantities of thinning are required before spray. In case of High Build epoxy coatings (two pack). 30:1 pump ratio and 0.020 – 0.023" tip size will provide a good spray pattern. Ideally fluid hoses should not be less than 3/8" ID and not longer than 50 ft. to obtain optimum results.

In case of gun choking, dechoking steps shall be followed immediately.

5.7.8 Brush application of paint shall be accordance with the following:

a. Brushes shall be of a style and quality that will enable proper application of paint.

b. Round or oval brushes are most suitable for rivets, bolts, irregular surfaces, and rough or pitted steel. Wide flat brushes are suitable for large flat areas, but they shall not have width over five inches.

c. Paint shall be applied into all corners.

d. Any runs or sags shall be brushed out.

e. There shall be a minimum of brush marks left in the applied paint.

f. Surfaces not accessible to brushes shall be painted by spray, daubers, or sheepkin.

5.7.9 Manual application by sling (where 6 O'clock position of pipe is not approachable)

A canvas strip (alternatively a tinplate strip) about 450 mm wide and 1.5 m long is hold under the pipe by two men. Liquid coating is poured on the sling at each side of the pipe. The men holding this sling move it up and down and walk slowly forward while fresh coating is poured on the pipe and they manipulate the sling so that an even coating is obtained all-round the bottom. This work shall be done very carefully and by experienced personnel. There shall not be any formation of "Whiskers" and holes in the coating. The coating film shall be inspected by mirror.

5.7.10 For each coat the painter should know the WFT corresponding to the specified DFT and standardise the paint application technique to achieve the desired WFT. This has to be ensured in the qualification trial.

5.8.0 Drying of coated Surfaces

5.8.1 No coat shall be applied until the preceding coat has dried. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum specified for it as a first coat; if it exceeds the paint material has possibly deteriorated or mixing is faulty.

5.8.2 No paint shall be force dried under conditions which will cause checking, wrinkling, blistering formation of pores, or detrimentally affect the condition of the paint.

5.8.3 No drier shall be added to a paint on the job unless specifically called for in the manufacturer's specification for the paint.

5.8.4 Paint shall be protected from rain, condensation, contamination, snow and freezing until dry to the fullest extent practicable.

5.9 Repair of damaged paint surface

5.9.1 Where paint has been damaged in handling and in transportation, the repair of damaged coating of pre-erection / fabrication shall be as given below:

5.9.2 Repair of damaged inorganic zinc silicate primer after erection / welding:

Quickly remove the primer from damaged area by mechanical scraping and emery paper to expose the white metal. Blast clean the surface if possible. Feather the primer over the intact adjacent surface surrounding the damaged area by emery paper.

5.9.3 Repair of damaged pre-erection and shop priming in the design temperature of –90°C to 500°.

- Surface preparation shall be done as per procedure 5.9.2.

- One coat of F-9 shall be applied wherever damaged was observed on pre-erection / pre-fabrication / shop primer of inorganic zinc silicate coating (F-9). F-9 shall not be applied if damaged area is not more than 5 x 5 cm.

5.10.0 Paint Application

5.10.1 Shop priming / pre-erection priming with F9 or F12 shall be done only on blasted surface.

5.10.2 Shop priming / pre-erection priming with F9 or F12 shall be done only with airless spray.

5.10.3 For large flat surface field painting shall be done by airless spray otherwise brush can be used.

5.11.0 Documentation

1. A written quality plan with procedure for qualification trials and for the actual work.

2. Daily progress report with details of weather conditions, particular of applications, no of coats and type of materials applied, anomalies, progress of work versus programme.

3. Results of measurement of temperature relative humidity, surface profile, film thickness, holiday detection, adhesion tests with signature of appropriate authority.

4. Particulars of surface preparation and paint application during trials and during the work.

5. Details of non-compliance, rejects and repairs.

6. Type of testing equi0pments and calibration.

7. Code and batch numbers of paint materials used.

TABLE-1 (For Clause 5.0)
SURFACE PREPARATION STANDARDS

S.NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)				REMARKS
		SWEDISH STANDARD SIS-05-5900 1967	SSPC-SP USA	NACE USA	BRITISH STANDARD BS-4232:1967	
1.	**MANUAL OR HAND TOOL CLEANING** REMOVAL OF LOOSE RUST, LOOSE MILL SCALE AND LOOSE PAINT, CHIPPING, SCRAPPIG, SANDING AND WIRBRUSHING, SURFACESHOULD HAVE A FAINT METALLIC SHEET.	ST 2	SSPC-SP-2			THIS METHOD IS APPLIED WHEN THE SURFACE IS EXPOSED TO NORMAL ATMOSPHERIC CONDITIONS WHEN OTHER METHODS CANNOT BE ADOPTED AND ALSO FOR SPORT CLEANING DURING MAINTENANCE PAINTING.
2.	**MECHANICAL OR POWER TOOL CLEANING** REMOVAL OF LOOSE RUST, LOOSE MILL SCALE AND LOOSE PAINT TO DEGREE SPECIFIED BY POWER TOOL CHIPPING, DESCALING, SANDING, WIRE	ST 3	SSPC-SP-3			-DO-

S.NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)				REMARKS
		SWEDISH STANDARD SIS-05-5900 1967	SSPC-SP USA	NACE USA	BRITISH STANDARD BS-4232:1967	
	BRUSHING AND GRINDING, AFTER REMOVAL OF DUST, SURFACE SHOULD HAVE A PRONOUNCED METALLIC SHEEN					
3.	**BLAST CLEANING (AIR& WATER** **THERE ARE FOUR COMMON GRADES OF BLAST CLEANING**					
3.1	**WHITE METAL** BLAST CLEANING TO WHITE METAL CLEANLINESS, REMOVAL OF ALL VISIBLE RUST, MILL SCALE, PAINT & FOREIGN MATTER 100% CLEANLINESS WITH DESIRED SURFACE PROFILE.	SA 3	SSPC-SP-5	NACE #1	FIRST QUALITY	WHERE EXTREMELY CLEAN SURFACE CAN BE EXPECTED FOR PROLONG LIFE OF PAINT SYSTEMS

S.NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)				REMARKS
		SWEDISH STANDARD SIS-05-5900 1967	SSPC-SP USA	NACE USA	BRITISH STANDARD BS-4232:1967	
3.2	**NEAR WHITE METAL** BLAST CLEANING TO NEAR WHITE METAL CLEANLINESS, UNTIL AT LEAST 95% OF EACH ELEMENT OF SURFACE AREA IS FREE OF ALL VISIBLE RESIDUES WITH DESIRED SURFACE PROFILE	SA 21/2	SSPC-SP-10	NACE #2	SECOND QUALITY	THE MINIMUM REQUIREMENT FOR CHEMICALLY RESISTANT PAINT SYSTEMS SUCH AS EPOXY, VINYL, POLYURETHANE BASED AND INORGANIC ZINC SILLICATE PAINTS. ALSO, FOR CONVENTIONAL PAINT SYSTEMS USED UNDER FAIRLY CORROSIVE CONDITIONS TO OBTAIN DESIRED LIFE OF PAINT SYSTEM
3.3	**COMMERICAL BLAST** BLAST CLEANING UNTIL AT LEAST TWO-THIRDS OF EACH ELEMENT OF SURFACE AREA IS FREE OF ALL VISIBLE RESIDUES WITH DESIRED SURFACE PROFILE	SA 2	SSPC-SP-6	NO.3	THIRD QUALITY	FOR STEEL REQUIRED TO BE PAINTED WITH CONVENTIONAL PAINTS FOR EXPOSURE TO MILDLY CORROSIVE ATMOSPHERE FOR LONGER LIFE OF THE PAINT SYSTEMS
3.4						

S.NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)				REMARKS
		SWEDISH STANDARD SIS-05-5900 1967	SSPC-SP USA	NACE USA	BRITISH STANDARD BS-4232:1967	
	BURSH-OFF BLAST BLAST CLEANING TO WHITE METAL CLEANLINESS, REMOVAL OF ALL VISIBLE RUST, MILL SCALE, PAINT & FOREIGN MATTER, SURFACE PROFILE IS NOT SO IMPORTANT	SA 1	SSPC-SP-7	NO.4		

6.0.0 PAINT MATERIAL

Paint manufacturers shall furnish all the characteristics of paint materials on printed literature, along with the test certificate for all the specified characteristics given in this specification. All the paint materials shall be of first quality and confirm to the following general characteristics as per the tables 6.1, 6.2 and 6.3.

Paints, primers and undercoats shall be obtained from the same manufacturer and except where a definite time is specified between mixing and application, shall be ready mixed for use. They shall be compatible with one another.

PAINT MATERIALS

TABLE: 6.1 PRIMER

S.NO.	DESCRIPTION	P-2	P-4	P-6
1.	Technical Name	Chlorinated rubber Zinc Phosphate Primer	Etch Primer / Wash Primer	Epoxy Zinc Phosphate Primer
2.	Type and composition	Single pack, air drying chlorinated rubber based medium plasticised with unsaponlliable plasticizer, pigmented with Zinc phosphate	Two pack polyvinyl Butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate	Two component polyamide cured epoxy resin medium, pigmented with zinc phosphate
3.	Volume Solids (approx.)	40%	7.8%	40%
4.	DFT (Dry film thickness) per coat (approx.)	40-50 micron	8-10 micron	40-50 micron
5.	Theoretical covering capacity in M2/coat/litre (approx.)	8-10	8-10	8-10
6.	Weight per litre in kgs/litre(approx.)	1.3	1.2	1.4
7.	Touch dry at 30°C (approx.)	30 minutes	2 hrs.	After 30 mins.
8.	Hard dry at 30°C (approx.)	Min : 8 hrs Max: 24hrs	Min : 2 hrs Max: 24hrs	Min : 8 hrs Max: 3-6 months
9.	Over coating Interval(approx.)	Min.: 8 hrs Max: No limitations	Min.: 4-6 hrs Max: 24 hrs	Min.: 8 hrs Max: 3-6 months
10.	Pot life (approx.) at 30°C for two component paints (approx.)	Not applicable	Not applicable	8 hrs

PAINT MATERIALS

TABLE: 6.2 FINISH PAINT

S.NO.	DESCRIPTION	F-2	F-3	F-6	F-7
1.	Technical Name	Acrylic polyurethane finish paint	Chlorinated based finish paint	Epoxy High Build finish paint	High build coaltar epoxy coating
2.	Type and composition	Two pack aliphatic isocynate cured acrylic finish paint	Single pack plasticised chlorinated rubber based medium with chemical and weather resistant pigments	Two pack polyamide / polyamine cured epoxy resin medium suitably pigmented	Two pack polyamide cured epoxy resin blended with coaltar medium, suitably pigmented
3.	Volume Solids (approx.)	40%	40%	62%	65%
4.	DFT (Dry film thickness) per coat (approx.)	30-40 micron	40-50 micron	100-125 micron	100-125 micron
5.	Theoretical covering capacity in M2/coat/litre (approx.)	10-13	8-10	5-6	5.2 – 6.5
6.	Weight per litre in kgs/litre(approx.)	1.3	1.2	1.4	1.5
7.	Touch dry at 30°C (approx.)	1 hr	30 minutes	3 hrs	4 hrs
8.	Hard dry at30°C (approx.)	Overnight	8 hrs	Overnight	48 hrs
9.	Over coating Interval(approx.)	Min.: Overnight (12hrs) Max: Unlimited	Min.: Overnight Max: Unlimited	Min.: Overnight Max: 5 days	Min.: 24 hrs Max: 5 days
10.	Pot life (approx.) at 30°C for two component paints (approx.)	6-8 hrs	Not applicable	4 –6 hrs	4 –6 hrs

PAINT MATERIALS

TABLE: 6.3 FINISH PAINT

S.NO.	DESCRIPTION	F-8	F-9	F-11	F-12
1.	Technical Name	Self-priming type surface tolerant high build epoxy coating (complete rust control coating)	Inorganic Zinc Silicate Coating	Heat resistant synthetic medium based two pack aluminium paint suitable up to 250°C dry temperature	Heat resistant silicone aluminium paint suitable up to 500°C dry temperature.
2.	Type and composition	Two pack epoxy resin based suitably pigmented and capable of adhering to manually prepared surface and old coating.	A two pack air drying self-curing solvent based inorganic zinc silicate coating	Heat resistant synthetic medium based two pack aluminium paint suitable upto 250°C	Single pack silicone resin based medium with aluminium flakes.
3.	Volume Solids (approx.)	72%	60%	25%	20%
4.	DFT (Dry film thickness) per coat (approx.)	100-125 micron	65-75 micron	20-25 micron	20-25 micron
5.	Theoretical covering capacity in M2/coat/litre (approx.)	6.0 – 7.2	8 – 9	10 – 12	8 – 10
6.	Weight per litre in kgs/litre(approx.)	1.4	2.3	1.2	1.1
7.	Touch dry at 30°C (approx.)	3 hrs	30 mts	3 hrs	30 mts

S.NO.	DESCRIPTION	F-8	F-9	F-11	F-12
8.	Hard dry at30°C (approx.)	24 hrs	12 hrs	12 hrs	24 hrs
9.	Over coating Interval(approx.)	Min.: 10 hrs Max: 6 months	Min.: 8 hrs at 20°C and 50% RH Max: Unlimited	Min.: 16 hrs Max: Unlimited	Min.: 16 hrs Max: Unlimited
10.	Pot life (approx.) at 30°C for two component paints (approx.)	90 mts.	4 – 6 hrs	Not applicable	Not applicable
11.	Temperature Resistance	-	-	250°C	500°C

F-14: Specially formulated polyamine cured coal tar epoxy suitable for –45°C to 125°C for application under insulation.

F-15: Two pack cold cured epoxy phenolic coating suitable for –45°C to 125°C for application under insulation.

F-16: Epoxy siloxane Amercoat 738.

Note :

1. Covering capacity and DFT depends on method of application. Covering capacity specified above are theoretical. Allowing the losses during the application, minimum specified DFT should be maintained.

2. All primers and finish coats should be cold cured and air drying unless otherwise specified.

3. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship should be ensured.

4. Technical data sheets for all paints shall be supplied at the time of submission of quotations.

5. Final painting shade shall be as per the Owner's standard colour coding scheme; Colour Coding scheme shall be furnished during detailed engineering stage.

6.4 **List of recommended manufacturers**

The paints shall conform to the specifications given above and the best quality in their products range of the reputed manufacturers. The manufacturer shall be approved during execution stage by owner/owner's consultant.

7.0.0 PAINT SYSTEMS

The paint system should vary with type of environment envisaged in their products range of the manufacturers.

PRIMERS & FINISH COATS COVERED IN TABLE NOS. 7.0 TO 15.0

PRIMERS

P-2	:	Chlorinated Rubber Zinc Phosphate Primer
P-4	:	Etch Primer / Wash Primer
P-6	:	Epoxy Zinc Phosphate Primer

FINISH COATS / PAINTS

F-2	:	Acrylic – Polyurethane finish paint
F-3	:	Chlorinated Rubber Finish Paint
F-6	:	High Build Epoxy finish coating
F-7	:	High Build Coal Tar epoxy coating
F-8	:	Self-priming surface Tolerant high Build Epoxy coating
F-9	:	Inorganic Zinc Silicate Coating
F-11	:	Heat resistant Synthetic medium based Aluminium paint
F-12	:	Heat resistant Silicone Aluminium paint
F-14	:	Specially formulated polyamine cured coal for Epoxy coating

F-15 : Epoxy phenolic coating
F-16 : Epoxy Siloxane Coating: Amercoat 738

TABLE 7.1: PRE-ERECTION / PRE-FABRICATION AND SHOP PRIMING FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL, STEEL STRUCTURES, PIPING AND EQUIPMENT ETC.

S.NO	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PANT SYSTEM	TOTAL DFT IN MICRONS(MIN.)	REMARKS
7.1.1	-90 to 400	SSPC-SP-10	1 COAT of F-9	65 – 75	NO OVER COATING IS TO BE DONE
7.1.2	401 to 500	SSPC-SP-10	1 COAT of F-12	40 –50	FINISH COAT AT SITE

TABLE 7.2: REPAIR OF PRE-ERECTION / PRE-FABRICATION AND SHOP PRIMING AFTER ERECTION / WELDING FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL, ITEMS IN ALL ENVIRONMENTS

S.NO	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PANT SYSTEM	TOTAL DFT IN MICRONS(MIN.)	REMARKS
7.2.1	-90 to 400	SSPC-SP-3 (FOR REPAIR ONLY) SSPC-SP-10	1 COAT of F-9	65 – 75	FOR DAMAGED AREA OF MORE THAN 5x5 CM
7.2.2	401 to 500	SSPC-SP-3 (FOR REPAIR ONLY) SSPC-SP-10	2 COAT of F-12	40 –50	FOR DAMAGED AREA OF MORE THAN 5x5 CM

TABLE 8.0: FIELD PAINT SYSTEM FOR NORMAL CORROSIVE ENVIRONMENT (FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL)

ALL NORMAL CORROSIVE AREAS SUCH AS OFFSITES, EXTERNAL SURFACES OF VESSELS, BLOWERS, PIPING, PUMPS, COMPRESSORS, STRUCTURAL STEEL WORKS, EXCLUDING TANK TOPS, INTERIOR OF TANKS ETC.

S.NO	DESIGN TEMPERATURE IN °C	SURFACE PREPARTION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FIELD PRIMER	FINISH PAINT		
8.1	-90 TO –15	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 @ 65-75 MICRON DFT / COAT	NONE	65 – 75	NO OVER COATING TO BE DONE. FOLLOW REAIR PROCEDURE ONLY ON DAMAGED AREAS OF PRE-ERECTION / PRE-FABRICATION PRIMER / COATING F-9
8.2	-14 TO 60	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 @ 65-75P DFT / COAT + 2 COATS OF P-2 @ 40 MICRON DFT / COAT	2 COATS OF F-3 @ 40 P DFT / COAT 2x40=80	225	
8.3	61 to 80	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 @65-75 MICRON DFT/COAT + 2 COATS OF P-6 @40P DFT / COAT 2x40=80	1 COAT OF F-6 @ 100 P DFT / COAT	245	

S.NO	DESIGN TEMPERATURE IN °C	SURFACE PREPARTION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FIELD PRIMER	FINISH PAINT		
8.4	81 TO 250	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 @ 65-75 MICRON DFT / COAT	3 COATS OF F-11 @ 20 MICRON DFT / COAT 3x20=60	125	
8.5	251 TO 400	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 @ 65-75 MICRON DFT/COAT	2 COATS OF F-12 @ 20 MICRON DFT / COAT 2x20=40	105	
8.6	401 TO 500	SSPC-SP-10	REPAIR AS PER 7.2.2	2 COATS OF F-12 @ 20 MICRON DFT / COAT 2x20=40	80	

TABLE 9.0: FIELD PAINT SYSTEM FOR CORROSIVE ENVIRONMENT (FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL

FOR ALL CORROSIVE AREAS ABOVE GROUND SPILLAGES OF ACID / ALKALI / SALT ARE LIKELY TO COME IN CONTACT WITH SURFACES SUCH AS EXTERNAL SURFACES OF UNINSULATED VESSELS, BLOWERS, PIPING, PUMPS, COMPRESSORS AND STRUCTURAL STEEL ETC.

S.NO	DESIGN TEMPERATURE IN °C	SURFACE PREPARTION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FIELD PRIMER	FINISH PAINT		
9.1	-90 TO –15	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 @ 65-75 MICRON DFT/COAT	NONE	65 – 75	REPAIR OF PRE-ERECTION / PRE-FABRICATION PRIMER SHALL BE DONE WHEREVER DAMAGE IS OBSERVED SURFACE PREPARATION IS REQUIRED ONLY FOR REPAIRING OF DAMAGED PRE-ERECTION / FABRICATION PRIMER
9.2	-14 TO 60	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 @ 65-75P DFT / COAT + 1 COAT OF P-6 @ 40 MICRON DFT / COAT	1 COATS OF F-6 @ 100 MICRON DFT / COAT + 1 COAT OF F-2 @ 40 MICRON DFT / COAT	245	
9.3	81 TO 400	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 @ 65-75 MICRON DFT / COAT	2 COATS OF F-12 @ 20 MICRON DFT / COAT 2x20=60	105	
9.4	401 TO 500	SSPC-SP-10	REPAIR AS PER 7.2.2	2 COATS OF F-12 @ 20 MICRON DFT / COAT 2x20=40	80	

TABLE 10.0: FIELD PAINT SYSTEM FOR HIGHLY CORROSIVE AREAS (FOR CARBON STEEL, LOW TEMPERATURE CARBON STEEL & LOW ALLOY STEEL) EXTERNAL SURFACES OF UNINSULATED VESSELS BLOWERS, PIPING, PUMPS, COMPRESSORS, STRUCTURAL STEEL ETC.

EXPOSED TO SPILLAGE OR FUMES OR HCL, H_2SO_4, SALTY WATER, WATER IMPINGEMENT, CHLORIDE ETC.

S. No.	DESIGN TEMPERA-TURE IN °C	SURFACE PREPARATION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FIELD PRIMER	FINISH PAINT		
10.1	90 TO –15	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F-9 @ 65-75 MICRON DFT / COAT	NONE	65-75	REPAIR PROCEDURE OF PRE-ERECTION / FABRICATION PRIMER SHALL BE FOLLOWED. NO OVERCOATING IS ALLOWED.
10.2	-14 TO 80	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F.9 @65-75 µ DFT / COAT + 1 COAT OF P-6 @ 40 µ DFT / COAT	2 COATS OF F-6 @ 100 µ DFT / COAT = 2 x 100 = 200 + 1 COAT OF F-2 @ 40 µ DFT / COAT	345	SURFACE PREPARATION IS REQUIRED ONLY FOR REPAIRING OF DAMAGED PRE-ERECTION / FABRICATION PRIMER
10.3	81 TO 400	SSPC-SP-10	REPAIR OF PRE-FABRICATION PRIMER 1 COAT OF F.9 @ 65-75 µ DFT / COAT	2 COATS OF F-12 @20 µ DFT / COAT 2 x 20 = 40	105	
10.4	401 TO 500	SSPC-SP-10	REPAIR AS PER 7.2.2	2 COATS OF F.12 @20 µ DFT / COAT 2 x 20 = 40	80	

TABLE 11.0: FIELD PAINT SYSTEM FOR CARBON STEEL STORAGE TANKS (EXTERNAL) FOR ALL ENVIRONMENTS

S.NO	DESIGN TEMPERATURE IN °C	SURFACE PREPARATION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FIELD PRIMER	FINISH PAINT		
11.1	EXTERNAL SHELL, WIND GIRDERS APPARATUSES, ROOF TOPS OF ALL ABOVE GROUND TANK INCLUDING TOP SIDE OF FLOATING ROOF OF OPEN TANK AS WELL AS COVERED FLOATING ROOF TANK AND ASSOCIATED STRUCTURAL WORKS, ROLLING AND STATIONARY LADDERS, SPIRAL STAIRWAYS, HANDRAILS FOR ALL ENVIRONMENTS FOR PRODUCT WATER, POTABLE WATER, ACIDS, ALKALIES SOLVENTS AND CHEMICALS ETC					
11.1.1	-14 TO 80	SSPC-SP-10	1 COAT OF F-9 @ 65-75 µ DFT/COAT + 1 COAT OF P-6 @ 40 µ DFT / COAT 65+40=105	1 COAT OF F-6 @ 100 µ DFT / COAT+ 2 COATS OF F-2 @ 40 µ DFT / COAT 2x40=80	285	
11.1.2	81 TO 500	SSPC-SP-10	1 COAT OF F-9 @ 65-75 µ DFT/COAT	2 COATS OF F-12 @ 20 µ DFT/COAT 2x20=40	105	
11.2	EXTERNAL SURFACES OF BOTTOM PLATE (SOIL SIDE) FOR ALL STORAGE TANKS					
11.2.1	-14 TO 80	SSPC-SP-10	1 COAT OF F-9 @ 65-75 µ DFT/COAT	3 COATS OF F-7 @ 100 µ DFT / COAT 3x100=300	365	F-7 SHOULD BE SUITABLE FOR IMMERSION SERVICE OF THE PRODUCTS GIVEN.

* Same as pre-erection / pre-fabrication primer

TABLE 12.0: FIELD PAINT SYSTEM FOR CARBON STEEL AND ALLOY STEEL STORAGE TANKS (INTERNAL)

S.NO	DESIGN TEMPERA-TURE IN °C	SURFACE PREPARTION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FIELD PRIMER	FINISH PAINT		
12.1	INTERNAL SURFACES OF UNDERSIDE OF FLOATING ROOF, INTERNAL SURFACE OF CONE ROOF, BOTTOM PLATE, ROOF STRUCTURE, STRUCTURAL STEEL, LADDERS, SUPPORTS FOR STORING PRODUCT WATER TANK AND POTABLE WATER TANK					
12.1.1	-14 TO 80	SSPC-SP-10	1 COAT OF F-9 @ 65-75 µ DFT/COAT	3 COATS OF F-7 @ 100 µ DFT / COAT 3x100=300	365	F-7 SHOULD BE SUITABLE FOR IMMERSION SERVICE OF THE PRODUCTS GIVEN
12.2	BARE SHELL OF INSIDE FLOATING ROOF TANKS AND CONE ROOF TANKS FOR PRODUCTSMENTIONED IN 12.1.					
12.2.1	-14 TO 80	SSPC-SP-10	PHOSPHATING TREATMENT WITH PHOSPHATING CHEMICALS (2 COATS)	2 COATS OF F-7 DFT / COAT 2x10=20	20	
12.3	FLOATING CONE ROOF TANKS FOR PETROLEUM PRODUCTS SUCH AS ATF, GASOLINE, NAPTHA, KEROSENE, MOTOR SPIRIT, INSIDE OF BOTTOM PLATE, UNDERSIDE OF FLOATING ROOF AND SHELL ABOVE MAXIMUM LIQUID LEVEL AND STRUCTURAL STEEL, LADDERS ETC					
12.3.1	-14 TO 80	SSPC-SP-10	1 COAT OF F-9 @ 65-75 µ DFT/COAT	3 COATS OF F-7 @ 100 µ DFT / COAT 3x100=300	365	F-6 SHOULD BE SUITABLE FOR IMMERSION SERVICE OF PETROLEUM PRODUCTS LIKE ATF, KEROSENE, PETROL ETC
12.4	BARE SHELL OF INSIDE OF FLOATING CONE ROOF TANKS FOR PRODUCTS MENTIONED IN 12.3					

S.NO	DESIGN TEMPERA-TURE IN °C	SURFACE PREPARTION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FIELD PRIMER	FINISH PAINT		
12.4.1	-14 TO 80	SSPC-SP-10	1 COAT OF F-9 @ 65-75 μ DFT/COAT	NONE	65-75	NO OVER COATING IS ALLOWED. SAME AS PER PRE-ERECTION PRIMER, IF ANY.
12.5	INTERNAL PROTECTIONOF FIXED ROOF TYPE STORAGE TANKS FOR POTABLE WATER : INSIDE OF SHELL, UNDER SIDE OF ROOF AND ROOF STRUCTURE INSIDE SURFACE BOTTOM PLATE AND STRUCTURAL STEEL WORKS, LADDERS, WALKWAYS, PLATFORMS ETC					
12.5.1	-14 TO 80	SSPC-SP-10	2 COATS OF P-9 @ 40 μ DFT/COAT 2x40=80	2 COATS OF F-6 @ 100 μ DFT / COAT 2x100=200	280	F-6 shall be suitable for immersion service
12.6	D.M(DEMINERALISED WATER) AND HYDROCHLORIC ACID(HCL) : INTERNAL SHELL, BOTTOM PLATE AND ALL ACCESSORIES					
12.6.1	-14 TO 80	SSPC-SP-10	EBONITE RUBBER LINING AS PER SMMS SPECIFICATIONS 6-06-204			
12.7	EG TAKS (INTERNAL SHELL, BOTTOM PLATE ROOF AND ALL ACCESSORIES)					
12.7.1	ALL	SSPC-SP-10	3 COATS VINYL CHLORIDE CO POLYMER AMERCOAT 23 @ 75•/COAT		225	
12.8	INSIDE PONTOON AND INSIDE OF DOUBLE DECK OF ALL FLOATING ROOFS					
12.8.1	-14 TO 80	SSPC-SP-3	1 COAT OF F-8 @ 100 • DFT / COAT	1 COAT OF F-6 @ 100 • DFT / COAT 1x100=100	200	
12.9	INTERNAL SURFACES OF AMINE & SOUR WATER STORAGE TANKS					

S.NO	DESIGN TEMPERA-TURE IN °C	SURFACE PREPARTION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FIELD PRIMER	FINISH PAINT		
12.9.1	-14 TO 80	SSPC-SP-10	1 COAT OF F-9 @ 65-75 · DFT / COAT	2 COATS OF F-15 @ 75· DFT / COAT 2x75=150	215 – 225	

TABLE 13.0: COATING SYSTEM FOR EXTERNAL SIDE OF UNDERGROUND CARBON STEEL PLANT PIPING AND TANKS

S.NO	DESIGN TEMPERATURE IN °C	SURFACE PREPARTION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FIELD PRIMER	FINISH PAINT		
13.1	CARBON STEEL PLANT PIPING (UNDERGROUND)					
13.1.1	YARD COATING					
13.1.1.1	25 TO 60	SSPC-SP-10	1 COAT OF SYNTHETIC FAST DRYING PRIMER, TYPE-B AS PERAWWA-C-203 (1991)	4MMTHICK COALTAR COATING WRAPPING AS PER AWWA-C-203 IN 2LAYERS OF EAH 2MM THICKNESS	4mm	CTE COATING SHALL CONFIRM TO120/5 AS PER BS:4164
13.1.2	OVER THE DITCH COATING					
13.1.2.1	25 TO 60	SSPC-SP-10	1 COAT OF SYNTHETIC FAST DRYING PRIMER, TYPE-B AS PER AWWA-C-203 (1991)	4MM THICK COALTAR BASED TAPE COATING AS PER AWWA-C-203 & AS PERSMMS EIL SPEC. 6-06-203 REV.2	4mm	

S.NO	DESIGN TEMPERATURE IN °C	SURFACE PREPARTION	PAINT SYSTEM		TOTAL DFT IN MICRONS (MIN.)	REMARKS
			FIELD PRIMER	FINISH PAINT		
13.2	CARBON STEEL PLANT PIPING (UNDER GROUND)					
13.2.1	61 TO 400	SSPC-SP-10	1 COAT OF F-9 @ 65-75 μ DFT / COAT	NONE	65-75	
13.3	EXTERNAL SIDE OF UNINSULATED UNDERGROUND STORAGE TANKS					
13.3.1	40 TO 80	SSPC-SP-10	1 COAT OF F-9 @ 65-75 μ DFT / COAT	3 COATS OF F-7 @ 100 μ DFT / COAT 3x100=300	365	
13.3.2	-90 TO –41 81 TO 400 °c	SSPC-SP-10	1 COAT OF F-9 @ 65-75 μ DFT / COAT OR 1 COAT OF AMERCOAT 738 @ 250 μ DFT/COAT	NONE NONE	65-75 250	

8.0.0 STORAGE

8.1.0 All paints and painting materials shall be stored only in rooms to be arranged by Contractor and approved by Engineer-in-charge for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent building. A signboard bearing the words "PAINT STORAGE - NO NAKED LIGHT - HIGHLY INFLAMMABLE" shall be clearly displayed outside.

9.0.0 COLOUR CODE FOR PIPING

For identification of pipelines, the colour code as per Table 18.1 shall be used. Paint materials for colour coding shall be as specified in this standard in clause 6.0.

9.1.0 Colour coding scheme for pipes, equipment, machinery & structures:

Description	Ground Colour	First Colour Band	Second Colour Band
Product Water	Sea Green	French Blue	Signal Red
Cooling Water	-do-	French Blue	-
Fire Water	Fire Red	Crimson Red	-
Sea Water	Sea Green	White	-
Compressed Air	Sky Blue	Signal Red	-
Plant Air	-do-	Silver Grey	-
Instrument Air	-do-	French Blue	-
CO_2	-do-	Light Grey	-
Sulfuric Acid	Dark Violet	Brilliant Green	Light Orange
Nitric Acid	-do-	French Blue	-do-
Hydrochloric Acid	-do-	Signal Red	-do-
Caustic	Smoke Grey	Light Orange	-
Chlorine	Canary Yellow	Dark Violet	-do-

9.2.0 The colour code scheme is intended for identification of the individual group of the pipeline. The system of colour coding consists of a ground colour and colour bands superimposed on it.

9.3.0 Ground Colours as given in Table-18.1 shall be applied throughout the entire length for uninsulated pipes, ground colour coating of minimum 2 m length or of adequate length not to be mistaken as colour band shall be applied at places requiring colour bands. Colour band(s) shall be applied at the following location.

a) At battery limit points
b) Intersection points & change of direction points in piping ways.
c) Other points, such as midway of each piping way, near valves, junction joints of service appliances, walls, on either side of pipe culverts.
d) For long stretch / yard piping at 50M interval.
e) At start and terminating points.

9.4.0 Identification Sign

9.4.1 Flow direction shall be indicated by an arrow in the location stated in Para a, b, c & d and as directed by Engineer-in-Charge.

9.4.2 Colours of arrows shall be black or white and in contrast to the colour on which they are superimposed.

9.4.3 Product names shall be marked at pump inlet, outlet and battery limit in a suitable size as approved by Engineer-in-Charge.

9.4.4 Size of arrow shall be either of those given in 18.5.

9.5.0 Colour Bands

9.5.1 As a rule minimum width of colour band shall conform to the following table:

Nominal Pipe Size	Width: L(mm)
3" NB and below	25 mm
Above 3" NB upto 6" NB	50 mm
Above 8" NB upto 12" OD	75 mm
Above 12" OD	100 mm

Note: For insulated pipes, nominal pipe size means the outside diameter of insulation. Nominal pipe size figures are to be in inches.

9.5.2 Colour band(s) shall be arranged in the sequence shown in Table 18.1 and the sequence follows the direction of flow. The relative proportional width of the first colour band to the subsequent bands shall be 4:1; minimum width of any band shall be as per Clause 18.5.1.

9.6 Whenever it is required by the Engineer-in-Charge to indicate that a pipeline carries a hazardous material, a hazard marking of diagonal strips of black and golden yellow as per IS:2379 shall be painted on the ground colour.

10.0.0 IDENTIFICATION OF VESSELS, PIPING ETC.

10.1.0 Equipment number shall be stencilled in black or white on each vessel, column, equipment & machinery (insulated or uninsulated) after painting. Line number in black or white shall be stencilled on all the pipelines of more than one location as directed by Engineer-in-Charge; Size of letters printed shall be as below:

Column & Vessels	-	150 mm (high)
Pump, compressor and other machinery	-	50 mm (high)
Piping	-	40-150 mm

10.2.0 Identification of Storage Tanks

The storage tanks shall be marked as detailed in the drawing.

11.0.0 INSPECTION AND TESTING

11.1.0 All painting materials including primers and thinners brought to site by Contractor for application shall be procured directly from manufacturers as per specifications and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable.

11.2.0 Engineer-in-charge at his discretion may call for tests for paint formulations. Contractor shall arrange to have such tests performed including batch wise test of wet paints for physical and chemical analysis. All costs there shall be borne by the Contractor.

11.3.0 The painting work shall be subject to inspection by Engineer-in-charge at all times. In particular, following stage wise inspection will be performed and Contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection are as follows:

a. Surface preparation

b. Primer application
c. Each coat of paint

In addition to above, record should include type of shop primer already applied on equipment e.g. Red oxide zinc chromate or zinc chromate or Red lead primer etc.

Any defect noticed during the various stages of inspection shall be rectified by the Contractor to the entire satisfaction of Engineer-in-charge before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work, Contractor shall be responsible for making good any defects found during final inspection / guarantee period / defect liability period as defined in general condition of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra cost to Owner, the extra cost should have prior approval of Engineer-in-Charge.

11.4.0 Primer Application

After surface preparation, the primer should be applied to cover the crevices, corners, sharp edges etc. in the presence of inspector nominated by Engineer-in-charge.

11.5.0 The shades of successive coats should be slightly different in colour in order to ensure application of individual coats, the thickness of each coat and complete coverage should be checked as per provision of this specification. This should be approved by Engineer-in-charge before application of successive coats.

11.6.0 The Contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.

Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of blast cleaning. Holiday detectors and pinhole detector and positector whenever required for checking in cast of immersion conditions.

11.7.0 Prior to application of paints on surfaces, the thickness of the individual coat shall be checked by application of each coat of same paint on M.S. test panel. The thickness of paint on test panel shall be determined by using gauge such as 'Elkometer', the thickness of each coat shall be checked as per provision of this specification. This shall be approved by Engineer-in-charge before application of paints on surface.

11.8.0 At the discretion of Engineer-in-charge, the paint manufacturer must provide the expert technical service at site as and when required. This service should be free of cost and without any obligation to the Owner, as it would be in the interest of the manufacturer to ensure that both surface preparation and application are carried out as per their recommendations.

11.9.0 Final inspection shall include measurement of paint dry film thickness, Adhesion, Holiday detection check of finish and workmanship. The thickness should be measured at as many points / locations as decided by Engineer-in-charge and shall be within +10% of the dry film thickness, specified in the specifications.

11.10.0 The Contractor shall arrange for spot checking of paint materials for Sp. gr., flow time (ford cup) and spreading rate.

12.0.0 GUARANTEE

12.1.0 The Contractor shall guarantee that the chemical and physical properties of paint materials used are in accordance with the specifications contained herein / to be provided during execution of work.

12.2.0 The Contractor shall produce test reports from manufacturer regarding the quality of the particular batch of paint supplied. The Engineer-in-charge shall have the right to test wet samples of paint at random, for quality of same, as stipulated in Clause 11 above. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the Contractor.

13.0.0 QUALIFICATION CRITERIA OF PAINTING CONTRACTOR

Painting contractor who is awarded any job for under this standard must have necessary equipments, machinery, tools and tackles for surface preparation, paint application and inspection. The contractor must have qualified, trained and experienced surface preparator, paint applicator, inspector and supervisors. The Contractor supervisor, inspector, surface preparator and paint applicator must be conversant with the standards referred to this specification. The Contractors capacity, capability and competency requirements for the job shall be quantified in the tender document and shall be assessed by a team appointed by the owner before awarding any job.

14.0.0 PROCEDURE FOR APPROVAL OF NEW COATING MATERIALS AND MANUFACTURERS

Following procedure is recommended to be followed for approval of new manufacturers.

14.1.0 The manufacturer should arrange testing of the inorganic zinc silicate coating materials as per the list of tests given in para 24.5 below from one of the reputed Government laboratories.

14.2.0 Samples of coating materials should be submitted to the Govt. laboratory in sealed containers with batch no. and test certificate on regular format of manufacturer's testing laboratory. The sampling shall be certified and sealed by a certifying agency.

14.3.0 All test panels should be prepared by Govt. testing agency-coloured photographs of test panels should be taken before and after the test and should be enclosed along with test report.

Sample batch no. and manufacturer's test certificate should be enclosed along with the report. Test report must contain details of observation and rusting if any, as per the testing code. Suggested Government laboratories are:

RRL, Hyderabad
HBTI, Kanpur
DMSRDE, Kanpur
IIT, Mumbai
BIS Laboratories
UDCT, Mumbai
RITES, Calcutta
PDIL

14.4.0 Manufacturers should intimate The Company, details of sample submitted for testing, name of Govt. testing agency, date, and contact personnel of the Govt. testing agency. At the end of the test the manufacturer should submit the test reports to the company for approval. The manufacturer(s) shall be qualified based on the results of these tests and other assessment and the Company's decision in this regard shall be final and binding on the manufacturer.

14.5.0 Tests required for evaluation of acceptance of coating materials for onshore application.

Test	ASTM Test Method
Density	D 1475
Dipping properties	D 823
Film Characteristics	
Drying time	D 1640
Flexibility	D 1737 / D 522
Hardness	D 3363
Adhesion	D 2197
Abrasion resistance	D 968 / D 1044
DFT / Coat	As per SSPC Guidelines
Storage Stability	D 1849
Resistance to	
Humidity for 2000 hrs.	D 2247
Salt Spray for 2000 hrs.	B 117
Accelerated Weathering	D 822
% Zn in DFT	G 53

LIST OF RECOMMENDED MANUFACTURERS

INDIAN VENDORS

1.0 Asian Paints (I) Ltd.

2.0 Berger Paints Ltd.

3.0 Goodlass Nerolac Paints Ltd.

4.0 Jerson and Nicholson Paints Ltd. & ChokuGu Jenson & Nicholson Ltd.

5.0 Shalimar Paints Ltd.

6.0 Sigma Coatings, Mumbai

7.0 CDC Carboline Ltd.

8.0 Premier Products Ltd.

9.0 Coromandel Paints & Chemicals Ltd.

10.0 Anupam Enterprises

11.0 Grand Polycoats

12.0 Bombay Paints Ltd.

13.0 Vanaprabha Esters & Glycer, Mumbai

14.0 Sunil Paints and Varnishes Pvt. Ltd.

15.0 Couraulds Coatings & Sealants India (Pvt.) Ltd.

16.0 Mark-Chem Incorporated, Mumbai (for phosphating chemicals only)

17.0 VCM Polyurethane Paints (for polyurethane paints only)

FOREIGN VENDORS FOR OVERSEAS PRODUCTS

1.0 Sigma Coatings, Singapore

2.0 Ameron, USA

3.0 Kansai Paint, Japan

4.0 Hempel Paints, USA

5.0 Valspar Corporation, USA

6.0 Courtaulds Coatings, UK

LIST OF RECOMMANDED MANUFACTURER'S PRODUCTS

SL. NO.	MANUFACTURERS NAME	P2 CHLORINATED RUBBER ZP PRIMER	P4 ETCH PRIMER / WASH PRIMER	P6 EPOXY ZINC PH. PRIMER	F-9 INORGANIC ZINC SILICATE PRIMER / COATING
1.	ASIAN PAINTS (I) LTD.	ASIOCHLOR HB.ZN.PH. PRIMER RO PC 168	APCONYL WP636 (PC 335)	APCODUR HB.RO.ZP-PC433	APCOCIL 605
2.	BERGER PAINTS LTD.	LINOSOL HIGH BUILD ZP PRIMER	BISON WASH PRIMER	EPILUX 610	ZINC ANODE 304
3.	AMERON / GOODLASS NEROLAC PAINTS LTD.		AMERCOAT 187	AMERCOAT 71	DIMETCOTE-9
4.	JENSON & NICHOLSON PAINTS LTD. AND CHOKUGU JENSON-NICHOLSON	JENSOLAC CHLORINATED RUBBER HB ZN.PH. PRIMER	J&N ETCH PRIMER	EPILAC ZINC PHOSPHATE PRIMER	
5.	SHALIMAR PAINTS LTD.	CHLOROKOTE ZINC PHOSPHATE PRIMER GREY	TUFFKOTE ETCH PRIMER	EPIGUARD 4 ZINC PHOSPHATE PRIMER GREY	TUFFKOTE ZILICATE TL
6.	SIGMA COATINGS	SIGMA NUCOL UNICOAT 7321	SIGMACOVER PRIMER (7413)	COLTURIET CM PRIMER 7412	SIGMASIL MC (7568)
7.	CDC CARBOLINE LTD.			CARBOLINE 893	CARBOZINC 11
8.	PRIMIER PRODUCTS LTD.			P-15/3A U-16/92	U17/92 ETHYL SILICATE INORGANIC ZINC
9.	CORAMANDEL PAINTS & CHEMICALS LTD.	COROCLORE CR HB. ZN. PH. PRIMER	CPC WASH PRIMER	COROPEX EPOXY ZN. PH. HIGH BILD PRIMER	
10.	ANUPAM ENTERPRISES	ANUCHLOR ZP PRIMER	ANUPRIME-291	ANUPAM ANLICOR A-EZP-500	
11.	GRAND POLYCOATS	GP CHLOROPRIME 601	GP PRIME 401		
12.	BOMBAY PAINTS LTD. / HEMPEL MARINE PAINTS	HEMPA TEX HIGHBUILD 4633	PENTOLITE WASH PRIMER 8520	HEMPEL'S SHOP PRIMER E1530	GALVASOL 1570
13.	VANAPRABHA ESTERS & GLYCERIDES	VEGCHLOR HB PRIMER 1143	VEG WASH PRIMER 1181	VEGEPOX 1241 Z/P	

SL. NO.	MANUFACTURERS NAME	P2 CHLORINATED RUBBER ZP PRIMER	P4 ETCH PRIMER / WASH PRIMER	P6 EPOXY ZINC PH. PRIMER	F-9 INORGANIC ZINC SILICATE PRIMER / COATING
14.	SUNIL PAINTS AND VARNISHES PVT. LTD.	SUNCHLOR HB ZINC PHOSPHATE PRIMER	SUN WASH	SUNPOXY ZINC PHOSPHATE PRIMER	
15.	COURTAULDS COATINGS LTD.			INTERGARD 251	INTERZINC
16.	MARK-CHEM INCORPORATED, (FOR PHOSPHATING CHEMICALS ONLY)	RUST PREVENTIVE LIQUID DRSAIO			
17.	VCM POLYURETHANE PAINTS (FOR POLY EURETHANE PAINTS ONLY)				
18.	JOTUN PAINTS			EPOXY CQ SPECIAL ZINC PHOSPHATE PRIMER	JOTACOTE-2
19.	KCC PRODUCTS (KOREA)				EZ 180(N)
20.	ASIAN PAINTS (I) LTD.	APCOTHANE CF676 (PC 1109)	ASIOCHLOR CF 621 (PC 161)	APCODUR HB COATING 9466	APCODUR CF 300
21.	BERGER PAINTS LTD.	BERGER THANE ENAMEL (81)	LINOSOL CHLORINATED RUBBER HB COATING	EPILUX 04 AND 78 HB EPOXY COATING	EPILUX 555
22.	AMERON/GOODLASS NEROLAC PAINTS LTD.	AMERCOAT 450GL	AMERCOAT 515	AMERCOAT 383 HS	AMERCOAT 78HB
23.	JENSON & NICHOLSON PAINTS LTD. AND CHOKUGU JENSON – NICHOLSON	J&N 993 HB POLYURETHANE FINISH PAINT	JENSOLAC HB CHLORINATED RUBBER FINISH PAINT	EPILAC 981 ENAMEL	EPILAC SOLVENTLESS COAT TAR EPOXY COATING
24.	SHALIMAR PAINTS LTD.	SHALITHANE FINISH	CHLORKOTE FINISH	EPIGARD XL FINISH	BIPIGARD S BLACK HB COAT TAR EPOXY COATING

SL. NO.	MANUFACTURERS NAME	P2 CHLORINATED RUBBER ZP PRIMER	P4 ETCH PRIMER / WASH PRIMER	P6 EPOXY ZINC PH. PRIMER	F-9 INORGANIC ZINC SILICATE PRIMER / COATING
25.	SIGMA COATINGS	SIGMADOUR HS SEMIGLOSS 7530	SIGMA NUCOL FINISH 7308	SIGMA COVER CM7456	COLTURIET TCN 300
26.	CDC CARBOLINE LTD.	CARBOLINE 132		CARBOLINE 191	CARBOMASTIC-14
27.	PRIMIER PRODUCTS LTD.	U3/92 POLYURETHANE	CR-71, CR FINISH PAINT	42B/4A HIGH BUILD EPOXY	350B/3A, COAL TAR EPOXY COATING
28.	COROMANDEL PAINTS & CHEMICALS LTD.		CAROCLORE CR FINISHING	COROPEX EPOXY HB COATING	COROPEX EPOXY COAL TAR COATING
29.	ANUPAM ENTERPRISES	ANUTHANE ENAMEL	ANUCHLOR HB ENAMEL	DURACOAT-6000	COROGUARD
30.	GRAND POLYCOATS	GP COAT 131, 132, GP BOND 141	GP CHLOROGUARD 631	GP GUARD HP234	POLYGUARD CE