SPECIFICATION FOR PAINTING:
PIPING & EQUIPMENTS

Hindustan Petroleum Corporation Ltd
Visakha Dispatch Station
VR-ATP Area, Naval Base Post
Visakhapatnam - 530 014
Andhra Pradesh

Mott MacDonal Consultants (India) Pvt. Ltd.
Kothari House, CTS No. 185
Off Andheri - Kurla Road
Andheri (East)
Mumbai 400 059
# SPECIFICATION FOR PAINTING: PIPING & EQUIPMENTS

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<th>Client</th>
<th>HINDUSTAN PETROLEUM CORPORATION LTD.</th>
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<td>MMC1 Project No.</td>
<td>254624</td>
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**Issue and Revision Record:**

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<th>Date</th>
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Abbreviations:

CS : Carbon Steel
DFT : Dry Film Thickness
DM : De-mineralized
GI : Galvanized Iron
ID : Internal Diameter
MS : Mild Steel
NB : Nominal Bore
OD : Outside Diameter
RCC : Reinforced Cement Concrete
WFT : Wet Film Thickness

Company : Mott Macdonald Consultants India Pvt. Ltd.
Owner : Hindustan Petroleum Corporation Limited
1 General

1.1 This technical specification 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 carry out the work in all respects with the best quality of materials and workmanship and in accordance with the best engineering practice and instructions of Company Site Representative.

1.2 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 Scope

2.1 Scope of work covered in the specification shall include, without being limited to the following.

2.1.1 This specification defines the requirements for surface preparation, selection and application of paints on external surfaces of piping, vessels, etc. The items listed in the heading of tables of paint systems is indicative only, however the contractor is fully responsible for supply of all paint materials, carrying out all the necessary painting, coating and lining on external and internal surfaces as per the tender requirement.

2.2 Extent of Work

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

   a. All uninsulated carbon steel piping fittings and valves (including painting of identification marks), furnace, ducts and stacks.

   b. All uninsulated C.S. equipment like columns, vessels, drums, heat exchangers, pumps, compressors, electrical panels and motors etc.

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

   d. All structural steel work, pipe, structural steel supports, Equipment like Pump etc; walkways, handrails, ladders, Platforms etc.

   e. Identification colour bands on all piping as required including insulated aluminium clad, Galvanized and nonferrous piping.

   f. Identification lettering / numbering on all painted surfaces of piping insulated aluminium clad, galvanized and non-ferrous piping.

   g. Marking / identification signs on painted surfaces of piping Hazardous service.

   h. Supply of all primers, paints and all other materials required for painting other than Owner's supply.

   i. Over insulation surface of pipes wherever required.

   j. Painting under insulation for carbon steel as specified.
2.2.2 The following surfaces and materials shall not require painting in general. However, if there are any specific requirements by the owner, the same shall be painted as per the relevant specifications:

   a. Plastic and / or plastic coated materials
   c. Non-ferrous materials like aluminium etc

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

2.4 Changes and deviations required for any specific job due to client requirement or otherwise shall be referred to Company for deviation permit.

3 Codes & Standards

3.1 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, 2004 Ed. : Paint Colour Code for Piping
   ASA A 13.1-1981 : Scheme for identification of piping systems:
                     American National Standards Institution.

3.2 Surface Preparation Standards

Following standards shall be followed for surface preparations:

3.2.1 Swedish Standard - SIS-05 5900-1967 (Surface preparations 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 Company Site Representative.

3.2.2 Steel Structures Painting Council, U.S.A. (Surface Preparation Specifications (SSPC-SP)).

3.2.3 British Standards (Surface Finish of Blast-cleaned for Painting) BS-4232.


3.3 The contractor shall arrange, at his own cost, to keep a set of latest edition of above standards and codes at site.
3.4 The paint manufacturer's instructions 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 recommended limit on time intervals between coats.

4 Equipment

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

4.2 Mechanical mixing shall be used for paint mixing operations in case of two pack systems except that the Company Site Representative may allow the hand mixing of small quantities at his discretion.

5 Surface Preparation, Non Compatible Shop Primer, Coating Procedure, Application & Repair and Documentation

5.1 General

5.1.1 In order to achieve the maximum durability, one or more of following methods of surface preparation shall be followed, depending on condition of steel surface and as instructed by Company Site Representative. 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 SA 2-1/2 OR equivalent as per Swedish Standard SIS-05-5900-1967 or equivalent. Where highly corrosive conditions exist, then blast cleaning shall be SA 3 as per Swedish Standard.

Remove all other contaminants, oil, grease etc. by use of an 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 exceed 85%. The temperature of the substrate shall be at least 3deg.C above the dew point. Desiccant type De-humidifiers shall be used to maintain the Relative Humidity and Temperature during the application of coating materials. The RH (Relative Humidity) shall be maintained at least that 60% and air temperature inside the tanks in the range of 25 – 40 deg.C shall be maintained for proper chemical curing of the two component (epoxy) internal coatings of storage tanks. The Dehumidifiers shall be based on at least two air charges per hour of the enclosure.
5.1.4 Irrespective of the method of surface preparation, the first coat of primer must be applied by brush 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 Company Site Representative shall have the liberty to control the time period, at his sole discretion and/or to insist on re-cleaning, 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 possible.

5.2 Procedure of Surface Preparation

5.2.1 Blast Cleaning

5.2.1.1 Shot/ Grit Blast Cleaning

The surfaces shall be blast cleaned using one of the abrasives: A1\textsubscript{2}O\textsubscript{3} particles chilled cast iron or malleable iron and steel at pressure of 7 kg/cm\textsuperscript{2} at appropriate distance and angle depending of 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 ¾”. 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 lustre. Primer or first coat of paint shall be applied within 4 hours of surface preparation. Blast cleaning shall not be done outdoors in bad 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 50 microns). If possible vacuum collector shall be installed for collecting the abrasives and recycling.

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 tables of paint systems.

Hand tool cleaning normally consists of the following:

a. Hand de-scaling 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, scraping 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 bushed, swept, dusted and blow 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 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 the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Company Site Representative.

5.4 Shop primed surfaces will only be 'spot cleaned' in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coat primer should be completely removed before application of selected paint system for particular environment.

5.5 Coating Procedure and Application

5.5.1 Surface shall not be coated in rain, wind or in environment where injurious airborne elements exists, when the steel surface temperature is less than 5˚F above dew point when the relative humidity is greater than 85% or when the temperature is below 40˚F. De-humidifier equipment shall be used to control the RH and Dew point for proper curing of internal coating of storage tanks.

5.5.2 Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no case later than 4 hrs. the same day.

5.5.3 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.

5.5.4 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 detrimental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer instruction shall be followed for inter coat interval.

5.5.5 When the successive coat of the same colour have 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.

5.5.6 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 atomizing 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 atomizing 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 over spray.

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 paint 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 patterns 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, finished flange faces, control valve items and similar items shall be masked to prohibit coating deposition. If these surfaces are coated, the component shall be cleaned and resorted 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 spray gun shows choking, immediately de-choking procedure shall be followed.

5.5.7 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 sued to operate a pump to produce pressures of 1000 to 6000 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 over spray. 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 any 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 coating (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, de-choking steps shall be followed immediately.
5.5.8 Brush application of paint shall be in accordance with the following:

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

b. Rounds or oval brushes are most suitable for rivets, bolts, irregular surface, 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 sheepskin.

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

a. A canvas strip (alternatively a tinplate strip) about 450 mm wide and 1.5m long is held under the pipe by two men from the top in a sling-like position.

b. It is then moved up and down and slowly moved forward while fresh coating is poured on top of the pipe.

c. The men 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 at the bottom by mirror.

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

5.6 Drying of coated surfaces

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

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

5.6.3 No drier shall be added to paint on the job unless specifically called for in the manufacturer’s specification for the paint.

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

5.7 Repair of damaged paint surface

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

5.7.2 Repair of damaged inorganic zinc silicate primer or Etch Primer after erection/welding:
Quickly remove the primer from damaged area by mechanical scraping and emery paper to expose the white metal. Blast cleans the surface if possible. Feather the primer over the intact adjacent surface surrounding the damaged area by emery paper.

5.7.3 Repair of damaged pre-erection and shop priming in the design temperature range of -90° C to 300° C.
- Surface preparation shall be done as per procedure 5.2.
- One coat of P-1 /P-2 shall be applied wherever damage is observed on pre-erection / pre-fabrication / shop primer of Inorganic Zinc Silicate coating (P-1) or Etch Primer (P-2).

5.8 Paint Application
5.8.1 Shop priming / pre-erection priming with P-1 shall be done only on blasted surface.
5.8.2 Shop priming / pre-erection priming with P-1 shall be done only with airless spray.
5.8.3 For large flat surface field painting shall be done by airless spray otherwise brush can be used.

5.9 Surfaces not to be painted
5.9.1 The following are not to be painted and must be protected from painting:
- Porcelain
- Gauge Glasses
- Meter Faces
- Valve Stem and Threads
- Working Surfaces of Equipment
- Name Plates
- Aluminum, Plastic and Stainless Steel
- Insulation or Fireproofing
- Galvanized Steel
- Concrete, Transite, Masonry, Stucco, Etc.
- Factory Finished Control Panels
- Factory Finished Instrument Cases and Meters
- Factory Finished Equipment, Including Filters, Control Valves, Etc.
- Factory Finished Buildings

5.9.2 Masking or compounds used to protect non-painted surface must be removed prior to completion of the job.
6 Documentation

- A written quality plan with procedure for qualification trials and for the actual work.
- Daily progress report with details of weather conditions, particular of applications, no of coats and type of materials applied, anomalies, progress of work versus program.
- Results of measurement of temperatures relative humidity, surface profile, film thickness, holiday detection, adhesion tests with signature of appropriate authority.
- Particulars of surface preparation and paint application during trials and during the work.
- Details of non-compliance, rejects and repairs.
- Type of testing equipments and calibration.
- Code and batch numbers of paint materials used.

6.1 Field Safety and Hygiene

Industrial hygiene and safe working practice in connection with the painting work shall be strictly followed to avoid potential hazards to health and of fire. Special care shall be taken with regard to the following matters:

6.1.1 When surfaces are to be prepared by blast cleaning or with the use of power tools, protectors such as goggles, mask etc. shall be used.

6.1.2 When painting work is to be carried out using organic solvent in an almost airtight environment, appropriate ventilating and lighting equipments shall be provided. Additionally, appropriate protectors such as gas masks etc. shall be worn.

6.1.3 Monitor for any fire around the work location and extinguish the fire prior to work, if observed.

6.1.4 All the safety requirements stated in the relevant equivalent Standards and its component parts apply in addition to any applicable federal, state and local rules and requirements. They shall be in accord with the instruction and requirements of insurance underwriters.
Table-1 (For Clause 5.0): Surface Preparation Standards

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Various International Standards (Equivalent)</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>1</td>
<td>Manual or hand tool Cleaning</td>
<td>Swedish Standard SIS-05-5900</td>
<td>This method is applied when the surface is exposed to normal atmospheric conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting.</td>
</tr>
<tr>
<td></td>
<td>Removal of loose rust, loose mill scale and loose paint, chipping, scrapping, standing and wire brushing. Surface should have a faint metallic sheen</td>
<td>SSPC-SP-2</td>
<td>--</td>
</tr>
<tr>
<td>2</td>
<td>Mechanical or power tool Cleaning Removal of loose rust loose mill scale and loose paint to degree specified by power tool chipping, de-scaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen.</td>
<td>ST.3</td>
<td>SSPC-SP-3</td>
</tr>
<tr>
<td>3.1</td>
<td>White metal Blast cleaning to white metal cleanliness. Removal of all visible rust. Mill scale, paint &amp; foreign matter 100% cleanliness with desired surface profile.</td>
<td>SA 3</td>
<td>SSPC-SP-5</td>
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</tbody>
</table>
| 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 2½ | SSPC-SP-10 | NACE# 2 | Second Quality The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc silicate paints, also for conventional paint systems used under fairly corrosive
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<th>Various International Standards (Equivalent)</th>
<th>Remarks</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Swedish Standard SIS-05-5900</td>
<td>British Standard BS-4232;</td>
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<tr>
<td></td>
<td></td>
<td>SSPC-SP USA</td>
<td>NACE, USA</td>
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<td></td>
<td></td>
<td></td>
<td>conditions to obtain desired life of paint system.</td>
</tr>
<tr>
<td>3.3</td>
<td>Commercial Blast</td>
<td>SA 2</td>
<td>NO.3 Third Quality</td>
</tr>
<tr>
<td></td>
<td>Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.</td>
<td>SSPC-SP-6</td>
<td>For steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.</td>
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<tr>
<td>3.4</td>
<td>Brush-off Blast</td>
<td>SA 1</td>
<td>NO.4</td>
</tr>
<tr>
<td></td>
<td>Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, paint &amp; foreign matter. Surface profile is not so important</td>
<td>SSPC-SP-7</td>
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7 Paint Materials

Paint manufacturers shall furnish the characteristics of all paints materials on printed literature, along with the test certificate for all specified characteristics given in this specification. All the paint materials shall be on first quality and conform to the following general characteristics as mentioned below.

7.1 Inorganic Zinc Silicate Coating (Code: P-1)

A two pack air drying self curing solvent based Inorganic Zinc silicate coating for use on steel surfaces.

- **Volume Solids (Approx.)**: 60% vol by solids
- **Dry film thickness per coat**: 65-75 microns
- **Theoretical Coverage**: 8-9 sq.m/ coat/litre
- **Weight per Litre**: 2.2 Kg/litre
- **Touch dry at 30°C**: 30 minutes
- **Hard Dry at 30°C**: 12 Hrs.
- **Over coating Intervals**: Min: 8 Hrs at 20°C & 50% RH
- **Pot life at 30°C**: 4-6 Hrs

7.2 Etch Primer (Code: P-2)

A two pack Polyvinyl butyral Resin medium cured with Phosphoric acid solution pigmented with Zinc Tetroxy Chromate.

- **Volume Solids (Approx.)**: 7-8%
- **Dry film thickness per coat**: 8-10micron
- **Theoretical Coverage**: 8-10
- **Weight per Litre**: 1.2
- **Touch dry at 30°C**: 2 Hrs
- **Hard Dry at 30°C**: 24 Hrs
- **Over coating Intervals**: Min: 4-6 Hrs
- **Pot life at 30°C**: not applicable

7.3 Zinc Phosphate Epoxy Primer (Code: P-3)

A Two component Polyamide cured epoxy resin medium, pigmented with zinc phosphate.

- **Volume Solids (Approx.)**: 40%
- **Dry film thickness per coat**: 40-50micron
- **Theoretical Coverage**: 8-10sq.m/coat/litre
- **Weight per Litre**: 1.4 Kg/litre
- **Touch dry at 30°C**: 30 minutes
- **Hard Dry at 30°C**: 24 Hrs
- **Over coating Intervals**: Min: 8 Hrs
- **Pot life at 30°C**: 8 Hrs
7.4 Polyamide Cured High Build Epoxy Micaceous Iron Oxide Coat (Code: F-1)

It is a two component High Build Epoxy Coating ideally suited for exterior application & pigmented with micaceous iron oxide (MIO), a lamellar plate-like pigment that forms a thick lustrous layers after application.

- Volume Solids (Approx.) : 53% volume by solid
- Dry film thickness per coat : 100-125 micron
- Theoretical Coverage : 5.3-4.24 sq.m/coat/litre
- Weight per Litre : -
- Touch dry at 30°C : 2-2.5 Hrs
- Hard Dry at 30°C : 5-6 days
- Over coating Intervals : -
- Pot life at 30°C : 6-8 Hrs

7.5 Acrylic Polyurethane Finish Paint (Code: F-2)

It is two pack Aliphatic Isocytane cured acrylic finish paint. Part-A consist of Polyacrylate Polyol with appropriate primer extenders, solvent and additives & part-B consist of Aliphatic Polyisocyanate with appropriate solvents and additives.

Part-A and Part-B are to be mixed together to form a pigmented polyurethane paint in suitable proportion as recommended by manufacturer.

- Volume Solids (Approx.) : 40-45%
- Dry film thickness per coat : 30-40 micron
- Theoretical Coverage : 10-13sq.m/coat/litre
- Weight per Litre : 1.3kg/litre
- Touch dry at 30°C : 1 Hr.
- Hard Dry at 30°C : Overnight
- Over coating Intervals : Min: Overnight (12 Hrs)
- Pot life at 30°C : 6-8 Hrs.

8 Painting System

8.1 Field Paint System for structural, utility, piping, Equipment, Hydrocarbon Pumps, Hydrocarbon lines (For Temperature less than 90°C) (Un insulated CS Lines):

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>TYPE</th>
<th>DFT (μ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Preparation</td>
<td>SA-2 1/2</td>
<td>--------</td>
</tr>
<tr>
<td>Primer Coat</td>
<td>P-1</td>
<td>70</td>
</tr>
<tr>
<td>Intermediate Coat</td>
<td>F-1</td>
<td>100</td>
</tr>
<tr>
<td>Final Coat</td>
<td>F-2</td>
<td>2 x 60</td>
</tr>
<tr>
<td><strong>TOTAL DFT</strong></td>
<td></td>
<td><strong>230</strong></td>
</tr>
</tbody>
</table>
8.2 For Galvanised Pipe/ Galvanised surface:

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>TYPE</th>
<th>DFT (µ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Preparation</td>
<td>ST.2</td>
<td>--------</td>
</tr>
<tr>
<td>Primer Coat</td>
<td>P-2</td>
<td>8</td>
</tr>
<tr>
<td>Intermediate Coat</td>
<td>P-3</td>
<td>50</td>
</tr>
<tr>
<td>Final Coat</td>
<td>F-2</td>
<td>2 x 40</td>
</tr>
<tr>
<td><strong>TOTAL DFT</strong></td>
<td></td>
<td><strong>138</strong></td>
</tr>
</tbody>
</table>

NOTES:

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

8.3 List of recommended Manufacturers

The paints shall conform to the specifications given above and best quality in their products range of manufacturers listed in Annexure-I.

9 Storage

All paints and painting materials shall be stored only in rooms to be arranged by contractor and approved by Company Site Representative 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 word “PAINT STORAGE – NO NAKED LIGHT – HIGHLY INFLAMMABLE” shall be clearly displayed outside.

10 Piping Colour Code

The colour code shall be followed as given in Annexure-II.

11 Identification of Vessels, Pumps, Piping Etc

As per colour coding given in Annexure-II

12 Inspection and Testing

13.1 All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufacturer as per specifications and shall be accompanied by manufacturer’s test certificates. Paint formulations without certificates are not acceptable.
13.2 Company Site Representative 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 & chemical analysis. All costs there shall be borne by the contractor.

13.3 The painting work shall be subject to inspection by Company Site Representative 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 Company Site Representative 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 Company Site Representative.

13.4 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 Company Site Representative.

13.4.1 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 Company Site Representative before application of successive coats.

13.4.2 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 sand blasting. Holiday detectors and pinhole detector and protector wherever required for checking in case of immersion conditions shall also be provided by the contractor.

13.4.3 Prior to application of paints on surfaces of chimneys, 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 panels 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 Company Site Representative before application of paints on surface of chimney.
13.4.4 At the discretion of Company Site Representative, 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.

13.4.5 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 Company Site Representative and shall be within + 10% of the dry film thickness, specified in the specifications.

13.4.6 The contractor shall arrange for spot checking of paint materials for Specific gravity, glow time (ford cup) and spreading rate.

13 Guarantee

14.1 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.

14.2 The contractor shall produce test reports from manufacturer regarding the quality of the particular batch of paint supplied. The Company Site Representative shall have the right to test wet samples of paint at random for quality of same, as per the paint materials specification. Batch test reports of the manufacturer’s for each batch of paints supplied shall be made available by the contractor. The contractor shall stand guarantee for carrying out the rectification/repair/re-painting of the defects/ failures of painting found during the execution of painting job and till the expiry of the defect liability period of total project as per the directions of the Site Representative of Company.

14 Qualification Criteria of Painting Contractor

Painting contractor who is awarded the job 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’s supervisor, inspector, surface preparator and paint applicator must be conversant with the standards referred in this specification. The painting job shall be carried out by the approved agencies of paint manufacturers and supervised by the approved paint manufacturers own representative or paint manufacturer their scheme (supply and apply basis).
Annexure 1: List of Recommended Manufacturers

**Indian Vendors**
1. Asian Paints (I) Ltd., Mumbai
2. Berger Paints Ltd., Kolkata
3. Goodlass Nerolac Paints Ltd., Mumbai
4. Chemguard Coatings, Mumbai (For Ameron, USA Products only)
5. Chokugu Marine paints Pte. Ltd., Mumbai/Singapore
6. Shalimar Paints Ltd., Kolkata
7. Sigma Coatings, Mumbai.
8. CDC Carboline Ltd., Chennai
9. Premier products Ltd., Mumbai
10. Coromandel Paints & Chemicals Ltd., Visakhapatnam
11. Anupam Enterprises, Kolkata
12. Grand Polycoats, Vadodara
13. Bombay Paints Ltd., Mumbai
15. Cipy Polyurethanes Pvt. Ltd., Pune
16. Gunjan Paints Ltd., Ahmedabad
17. Advance Paints Ltd., Mumbai
18. VCM Polyurethane Paints (for polyurethane paints only)
19. Jotun Paints, Chennai (Singapore)
20. Chembond Chemicals Ltd., Navi Mumbai

**Foreign Vendors**
1. Sigma Coatings, Singapore
2. Ameron, USA
3. Kansai Paints, Japan
4. Hempel Paints, USA
5. Valspar Corporation, USA
6. Akzo Nobel/International Coatings, UK
7. Jotun Paints, Singapore

**For De-humidification equipment (on Rental Basis)**
1. Technical Drying Equipment (Asia) Pvt. Limited, Gurgaon, Haryana

The following are approved vendors for speciality items (phosphating chemical) only.
1. Mark-chem Incorporated, Mumbai.
2. Chemtreat India Ltd., Navi Mumbai
Annexure 2: Paint Colour Code for Piping

The following colour coding shall be followed:

<table>
<thead>
<tr>
<th>SHADE CODE</th>
<th>SERVICES</th>
<th>COLOUR SHADES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>GROUND COLOR</td>
</tr>
<tr>
<td>1</td>
<td>High speed diesel oil I</td>
<td>Oxford Blue No. 105 (IS – 5)</td>
</tr>
<tr>
<td>2</td>
<td>High speed diesel oil II</td>
<td>Oxford Blue No. 105 (IS – 5)</td>
</tr>
<tr>
<td>3</td>
<td>Motor spirit oil I</td>
<td>Dark Orange No. 591 (IS – 5)</td>
</tr>
<tr>
<td>4</td>
<td>Motor spirit oil II</td>
<td>Dark Orange No. 591 (IS – 5)</td>
</tr>
<tr>
<td>5</td>
<td>Super kerosene oil</td>
<td>Golden Yellow No. 356 (IS – 5)</td>
</tr>
<tr>
<td>6</td>
<td>Soft super kerosene oil</td>
<td>Golden Yellow No. 356 (Dark) (IS – 5)</td>
</tr>
<tr>
<td>7</td>
<td>Aviation turbine fuel</td>
<td>Golden Yellow No. 356 (Dark) (IS – 5)</td>
</tr>
<tr>
<td>8</td>
<td>Naphtha</td>
<td>IS - 412 Dark Brown (IS – 5)</td>
</tr>
<tr>
<td>9</td>
<td>Mineral turpentine oil</td>
<td>Bus Green No. 299 (IS – 5)</td>
</tr>
<tr>
<td>10</td>
<td>Hexane</td>
<td>Canary Yellow No. 304 (Note-2)</td>
</tr>
<tr>
<td>11</td>
<td>Ethanol</td>
<td>Dark Violet No. 796 (IS – 5)</td>
</tr>
<tr>
<td>12</td>
<td>White oil / slop oil</td>
<td>Dove Grey No. 694 (IS – 5)</td>
</tr>
<tr>
<td>13</td>
<td>Raw water</td>
<td>Sea Green No. 217 (Note-2)</td>
</tr>
<tr>
<td>14</td>
<td>Service water</td>
<td>Sea Green No. 217 (Note-2)</td>
</tr>
<tr>
<td>15</td>
<td>Filtered water</td>
<td>Sea Green No. 217 (Note-2)</td>
</tr>
<tr>
<td>SHADE CODE</td>
<td>SERVICES</td>
<td>COLOUR SHADES</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------------------------------</td>
<td>----------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GROUND COLOR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FIRST COLOR BAND</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SECOND COLOUR BAND</td>
</tr>
<tr>
<td>16</td>
<td>Storm water drain</td>
<td>Sea Green No. 217 (Note-2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Gardening water</td>
<td>Sea Green No. 217 (Note-2)</td>
</tr>
<tr>
<td>18</td>
<td>Continuous oil contamination</td>
<td>Sea Green No. 217 (Note-2)</td>
</tr>
<tr>
<td>19</td>
<td>Process water</td>
<td>Sea Green No. 217 (Note-2)</td>
</tr>
<tr>
<td>20</td>
<td>Nitrogen</td>
<td>Canary Yellow No. 304 (Note-2)</td>
</tr>
<tr>
<td>21</td>
<td>Fresh water</td>
<td>Sea Green No. 217 (Note-2)</td>
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<tr>
<td>22</td>
<td>Fire water</td>
<td>Fire Red No. 536 (IS – 5)</td>
</tr>
<tr>
<td>23</td>
<td>Plant air</td>
<td>Sky Blue No. 101 (Note-2)</td>
</tr>
<tr>
<td>24</td>
<td>Cooling water supply</td>
<td>Verdigris Green 280 (IS – 5)</td>
</tr>
<tr>
<td>25</td>
<td>Cooling water return</td>
<td>Verdigris Green 280 (IS – 5)</td>
</tr>
<tr>
<td>26</td>
<td>Instrument Air</td>
<td>Sky Blue No. 101 (Note-2)</td>
</tr>
<tr>
<td>27</td>
<td>Potable Water</td>
<td>Sea Green No. 217 (Note-2)</td>
</tr>
</tbody>
</table>

Notes:
1. Application and arrangement of colour bands shall be as per IS 2379 – 1990.
2. Service wise selection of colour is as per IS 2379 – 1990, colour shades as per IS - 5