



**OFFSHORE  
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SECTION**

**SPECIFICATION FOR  
PROTECTIVE  
COATING**

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## 1.0 INTRODUCTION

### 1.1 Scope

This specification covers the minimum requirements governing surface preparation, selection and application of the protective coating system to be used on the interior and exterior surfaces of all types of production facilities including structural steel, vessels, piping and equipment on offshore platforms.

Individual equipment specifications and /or drawings, when furnished, are to be used with these specifications. If conflict exists, the individual specifications and/or drawings shall govern. Since maintenance –painting requirements are usually different from that necessary for new construction, salient points for each will likewise be addressed separately.

It includes the requirements with respect to protection against corrosion of both Ferrous and non-ferrous metals of all types of production facilities including structural Steel, vessels, piping and equipment on offshore platforms, SBMs.

This specification also covers the performance-based coating standard and is Applicable to painting and coating, for new construction, modifications and Maintenance of offshore facilities. All paint and coating systems to be used shall Meet the qualification requirements and the minimum coating system requirements as specified in this specification.

The coating systems to be used in accordance with this specification shall be Suitable for a Marine environment C5-M, High Durability (H) as specified in ISO 12944, NORSOK M-501 & NACE SP 0108.

### 1.2 Definitions

The following definitions shall apply:

COMPANY : Shall mean ONGC or the designated representative.

CONTRACTOR : Shall mean the party contracted to perform the work in accordance with the drawings, specifications and work scope.

## 2.0 CODES AND STANDARDS

### 2.1 Mandatory Statutory Requirements

This document has been prepared to the International Standards detailed within. The CONTRACTOR shall ensure that the Work is executed in accordance with international standards, Statutory & Regulatory requirements.

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## 2.2 Codes and Standards & Regulations

The requirements of the latest published versions of the following listed Codes, Recommended Practices. Specifications and standards shall be met.


### 2.2.1 Steel Structure Painting Council (SSPC)

SSPC-PA1	Shop, Field and Maintenance Painting of Steel.
SSPC-PA2	Measurement of Dry Coating Thickness with Magnetic Gauges
SSPC-SP1	Solvent Cleaning
SSSC-SP2	Hand Tool Cleaning
SSPC-SP3	Power Tool Cleaning
SSPC-SP5	White Metal Blast Cleaning
SSPC-SP6	Commercial Blast Cleaning
SSPC-SP7	Brush –Off Blast Cleaning
SSPC-SP10	Near White Blast Cleaning
SSPC-SP11	Power Tool Cleaning to bare metal
SSPC-SP12	Surface Preparation & cleaning of Steel and Other Hard material by High and Ultra High Pressure Water Jetting prior to recoating
SSPC-AB1	Mineral and Slag Abrasive
SSPC-AB3	Ferrous Metallic Abrasive
SSPC-SP20	zinc rich coating Type-I(Inorganic ) & Type-II (Organic)
SSPC-SP COM	Surface Preparation and Abrasives Commentary, SSPC Painting Manual, Volume 2, “Systems and Specifications”
SSPC VIS-1	Visual Standard for Abrasive Blast Cleaned Steel
SSPC Vol.2	SSPC Painting Manual

### 2.2.2 American Society for Testing and Materials (ASTM)

ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Zinc-Coating (Hot-Dip) on iron and Steel Hardware
ASTM D4228	Standard practice for qualification of coating applicators for application of coating on steel surfaces.
ASTM B117	Salt Spray Test
ASTM G8	Cathodic Disbonding Test
ASTM G50	Standard practice for conducting atmospheric corrosion test
ASTM G53	Weathering Test (Part B)
ASTM D520	Zinc Dust (Metallic Zinc Powder)
ASTM D523	Specification for Gloss
ASTM D610	Standard Practice for evaluation degree of rusting of painted steel surfaces
ASTM C 633	Test Method for Adhesive/Cohesive Strength of Flame Sprayed Coating
ASTM D1200	Viscosity
ASTM D1640	Drying time

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<b>2.2.4 British Standard</b> <table><tr><td>BS 476: Part 20/21</td><td>Intumescent Coating</td></tr><tr><td>BS 2569:</td><td>Specification for Sprayed Metal Coating</td></tr><tr><td>BS 3900 Part G7</td><td>Heat Resistance Test</td></tr></table>				BS 476: Part 20/21	Intumescent Coating	BS 2569:	Specification for Sprayed Metal Coating	BS 3900 Part G7	Heat Resistance Test																						
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	related products
ISO 1461	Hot dip galvanized coating on fabricated iron and steel articles- Specification and test methods
ISO 14713	Protection against corrosion of iron and steel structure-zinc and aluminum coating.
ISO 4624	Adhesion test of paint
ISO 12944	A Global Corrosion standard
ISO 4628	Evaluation of degradation of paint coating
ISO 834	Hydrocarbon Resistance Design (PFP)
ISO 20340	Paints and varnishes – Performance requirements for protective paint systems for offshore and related structures.
ISO 4628-6	Paints and varnishes – Evaluation of degradation of paint coatings – Designation of intensity, quantity and size of common types of defect – Part 6: Rating of degree of chalking by tape method

**2.2.6 Occupational Safety and Health Act**

OSHA	Occupational Safety and Health Act
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**2.2.7 NACE Standards**

NACE Standard RP0188	Discontinuity (Holiday) Testing of Protective Coating
NACE Standard RP0287	Surface profile Measurement of abrasive blast cleaned steel surfaces using a replica tape.
NACE RP0198	The control of Corrosion Under Thermal Insulation & Fire Proofing Materials-A System Approach
NACE Standard RP 0176-94	Corrosion control of Steel Fixed Offshore Platforms Associated with Petroleum Production
NACE SP 0108	Corrosion control of Offshore Structure by protective coating
NACE 012	Specification for Application of Thermally Sprayed Aluminum Coating (TSAC)

**2.2.8 Underwriters Laboratories**

UL1709	Hydrocarbon Fire Resistant Design (PFP)
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**2.2.9 NORSOK Standard**

M-501	Surface Preparation and Protective coating
M-001	Material Selection

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**2.2.10 American Welding Society (AWS)**


AWS C.2.17	Recommended Practice for Electric Arc Spray
AWS C.2.18	Guide for Protection of steel with Thermal Spray Coating of Aluminium ,Zinc and Their alloys and composites
AWS C.2.23	Specification for Application of Thermally Sprayed Coatings (metalizing) of aluminium ,Zinc and Their alloys and composites for corrosion protection of steel

**2.2.11 RAL 840 HR ACQPA: COLOUR CHART**


**2.2.12 Abbreviations and Definitions**

APAS	Australian Paint Approval Scheme
ASTM	The American Society for Testing and Materials
C	Coating Thickness of metallic Zn (HDG coating)
COT	College of Occupational Therapists, (UK)
CP	Cathodic Protection DFT Dry Film Thickness
CPS	coating procedure specification
CPT	coating procedure test
CSDS	coating system data sheet
DFT	Dry Film Thickness
GRP	Glass Reinforced Plastic (fiber glass)
HB	High Build Epoxy
HDG	Hot-Dip Galvanized
HP	High Pressure (as in Water Washing at pressures above 300 Bar)
ITP	Inspection and Test Plan $\mu$ m Micron
IMO	International Maritime Organization
ISO	International Organization for Standardization
MSDS	Material Safety Data Sheet
MEK	methyl ethyl ketone
MSC	Maritime Safety Committee
NACE	National Association of Corrosion Engineers
NSF	National Science Foundation
OH&S	Occupational Health and Safety
PFP	Passive Fire Protection
PIG	Paint Inspection Gauge
PPE	Personal Protection Equipment
PSPC	Performance Standard for protective Coatings
QA	Quality Assurance as defined by ISO 9001 and 9002 Quality Systems
QC	Quality Control of production processes by activity
RH	Relative Humidity
S/S	Stainless steel Supplier
UHP WJ	Ultra High Pressure Water Jetting (> 2000 Bar)

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UL VOC WB-IZS WFT	Underwriters Laboratories volatile organic compound Water Borne - Inorganic Zinc Silicate Wet Film Thickness										
<b>3.0 GENERAL</b>											
<b>3.1</b> Selection of Coating systems and application procedure shall be made with due consideration to conditions during fabrication, installation, and service of Installation.											
All painting activities shall be incorporated in the fabrication plan.											
Details of Management, Inspectors, operators, facilities, equipments and qualified procedures shall be established and document before commencing work.											
Following items shall not be coated unless otherwise specified.											
<ul style="list-style-type: none"><li>• Fibre-glass</li><li>• plastic or other non-metallic finish</li><li>• Equipments, valves, etc. having factory coated finish</li><li>• Indicators</li><li>• Sprinklers, fusible plugs and fire detectors</li><li>• Control Valve Stems</li><li>• Stainless Steel Control Panels</li><li>• Stainless Steel Tubing and pipe – work</li><li>• Cupro-Nickel (CuNi) pipe work</li><li>• Glass Reinforced Epoxy (GRE) pipe work</li></ul>											
The following specific items shall not be coated and shall be protected from blasting and coating being applied to adjacent equipment											
<ul style="list-style-type: none"><li>• Bearings and seals</li><li>• Flange mating faces, Raised Face (RF) and Ring Type Joint (RTJ) and flat faced</li></ul>											

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- Instrument dials and/or cases
- Cable trays and cables
- Level gauge glasses
- Nameplates Shafts and similar polished or machined surfaces Instrument Tags and Valve Position.

### 3.2 Standard Coating

The manufacturer's standard coating shall be used for the following equipment

- Indoor electrical equipment
- Instrument and control panels
- Insulated rotating equipment

### 3.3 Equipment Cleaning

The following equipment shall be cleaned with biodegradable, water soluble cleaner and an epoxy primer shall be applied (tie-coat) to the manufacturer's standard coatings prior to the specified intermediate coat.

- Fan and blower housing
- Outdoor electrical equipment
- Engines and electric motors
- Pumps, compressors and other non-insulated rotating equipment
- Control and relief valves


Equipment shall be recoated as specified if the coating system applied by equipment manufacturer/packager does not comply with this specification or if coating repairs is necessary.

### 3.4 Flanges

Flanges on piping and valves (including control and relief valves) shall have a primer coat applied to bolt holes and the non-contact area of the face prior or being made-up. After make-up of these connections intermediate and finish coats shall be applied. Flanged

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ends shall have a finish coat as required in this Specification. Flange faces must not be coated.

**3.5 Piping Spools**

Primer and intermediate coatings and finish coat as per clause 13.2.2 shall be applied to spools pre-fabricated for offshore installation. If these spools have an end prepared for field welding, the coatings shall stop 150 mm from the prepared end.

**3.6 Seal Welding**

Where enclosed or inaccessible areas cannot be adequately painted, the areas shall be completely enclosed and seal welded. Small areas inaccessible to blasting and painting that cannot be boxed by welding shall be filled with epoxy mastic, caulking compound or other suitable filler to prevent retention of dirt and moisture.

**3.7 Overspray**

Adjacent structures, equipment and all other items shall be protected from blasting, overspray and drips with tarpaulin, plastic, tapes etc.

**3.8 Nozzles Through Insulation**

Flanged nozzles, man ways, platform clips, saddles and other attachments that extend through insulation shall be coated in accordance with the coating schedule for equipment and piping.

**3.9 Coated Bolts**


Galvanized bolts, studs and nuts, where used to bolt up piping, valves etc. or otherwise used to connect painted items, shall receive a top coat of paint over exposed areas after the connections are made. And shall be top coated with anti rust grease.

**4.0 SAFETY**

Safety conditions shall be met, as required by the Occupational Safety and Health Act (OSHA) or other governing bodies, as well as those that are the deemed necessary.

Particular care must be exercised when working in close or confined spaces, especially when spraying. The maximum allowable concentration of solvent in the air shall not be exceeded. Refer to the manufacturer's recommendations to determine the maximum allowable concentration value. When volatile solvents are flammable, the concentration in air shall be kept below 25 percent of the lower explosive limit by use of adequate exhaust or ventilation facilities.

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### 5.0 ENVIRONMENTAL REQUIREMENTS

The contractor will recognize COMPANY’s commitment to preserving the environment and shall comply with local codes and standards for transporting, storing, and disposing of hazardous materials and hazardous wastes.

Upon completion of the job, the contractor shall notify the COMPANY of the volume and type of hazardous waste generated.

Upon completion of the job, all non-hazardous wastes, such as empty paint cans, clothes blasting abrasives and equipment, shall be removed by the contractor from the job sites and properly disposed.

### 6.0 SURFACE PREPARATION

#### 6.1 General

The surface preparation procedures and requirements except for galvanizing and cadmium plating shall be in accordance with Steel Structural Painting Council (SSPC) - SP5, SP6, SP7 & SP10 and ISO–8501-1.

All fabrication and assembly shall be completed before surface preparation is taken up. Blast and application of coating to structural and piping items prior to assembly will be permitted provided surface preparation for splice ends are taken up by portable blasting tools before application of prime coat. All field splice surface preparation for Structure & Piping Items shall be carried out using portable blasting tools at field. All welding slag, weld spatters and burrs shall be removed prior to blasting. All bolt holes shall be drilled and their edges smoothed prior to blasting.


**First step of surface preparation:** Solvent cleaning is to be taken up for any surface preparation.

**Second step of surface preparation:** Steel surface shall be blast cleaned to develop specific anchor pattern/profile to develop efficient bond between paint & steel surface using blasting tool or portable blasting tools for all Structural, Piping & Pressure Vessel items.

Surface preparation for Equipment, Equipment Manufacturer’s procedure shall be submitted for approval of Company.

In case of modification work on Old Platform or Maintenance work, portable blasting tool shall be used for surface preparation. However, use of Power Tool / Hand Tool cleaning methodology can be used with approval of Company establishing constraint in use of portable blast tool and shall be applicable for specific location (not for as whole of the work/project) only.

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### 6.2 Requirements of Blasting

Only dry blasting procedures are allowed. Definitions of and requirements for, the various methods of surface cleaning are given below:

- A. White Metal Blast: As per SSPC SP5 & visual reference Sa3 as per ISO 8501-1.
- B. Near-White Blast: As per SSPC SP10 & visual reference Sa2.5 as per ISO 8501-1.
- C. Commercial Blast: As per SSPC SP6 & visual reference Sa2 as per ISO 8501-1.
- D. Brush-off Blast: As per SSPC SP7 & visual reference Sa1 as per ISO 8501-1

### 6.3 Pre Blasting preparation

#### 6.3.1 Rough Edges

Sharp edges, fillets, corners and welds shall be rounded or smoothened by grinding (minimum radius 2 mm).Hard surface layers (e.g. resulting from flame cutting) shall be removed by grinding prior to blast cleaning according to ISO 8501-3, Grade-3.

All surfaces should be washed with clean fresh water prior to blast cleaning.

Any major surface defects, particularly surface laminations or scabs detrimental to the protective coating system shall be removed by suitable dressing. Where such defects have been revealed during blast cleaning, and dressing has been performed, the dressed area shall be re-blasted to the specified standard. Surface pores, cavities etc. shall be removed by suitable dressing or weld repair.

#### 6.3.2 Weld Flux and Spatter

Weld flux, slag spatter, slivers etc. shall be ground smooth before blasting. Welding surface imperfections shall be removed and surface profile shall be prepared as per ISO 12944-3.


Any surface on which grinding is done shall be spot blast cleaned or power tool cleaned to obtain required anchor pattern.

All welds shall be inspected and if necessary repaired prior to final blast cleaning of the area.

#### 6.3.3 Surface Cleaning

Prior to blasting, all deposits or grease or oil shall be removed from the surface in accordance with SSPC-SP1 Solvent Cleaning using biodegradable water soluble cleaner.

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6.3.4 Chemical Contamination

All chemical contamination shall be neutralized and/or flushed off prior to any other surface preparation.

6.3.5 Equipment Protection

Items such as motors, machined surfaces, gauges, electrical and instrumentation items tags and nameplates, stainless steel galvanized steel, aluminum, brass, plated surfaces etc. shall be protected to prevent damage or contamination during blasting or painting.

Prior to blasting, openings on engines, pump, vessels, piping etc. shall be effectively sealed to prevent abrasive entering and damaging internal components. All packaged equipment shall be covered and special care taken to cover and seal all instrumentation.

6.4 Blasting Operations

6.4.1 Weather conditions

Blast cleaning shall not be done on any surface that is moist, or that may become moist, before the application of a primer.

No blasting is permitted when the steel temperature is less than 3°C above the dew point, as measured by a sling hydrometer, or when the relative humidity of the air is more than 85 %.

6.4.2 Preliminary Blasting

If blasting is performed at night, the surfaces shall be re-blasted the following day to provide the specified surface preparation standard and the anchor profile required for the specified coating system.

6.4.3 Blasting and Painting


Blasting shall not be done adjacent to painting operations or coated surfaces that are not fully dry. Blasting shall overlap previously coated surfaces by at least 150 mm.

6.4.4 Post – Blasting Procedure

The surface to be coated shall be clean, dry, free from oil/grease, and have the **specified anchor pattern/ roughness** and cleanliness until the priming coat is applied. Blast cleaned steel surfaces shall not be touched by bare hands.

Chloride contamination shall be checked **on the blasted steel surface prior to coating application** using Salt Contamination Meter - SCM 400 / **Bresle** patches / Quantab strips.

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Maximum permissible limit shall be 20 mg/m<sup>2</sup> for external surface & 50 mg/m<sup>2</sup> for internal of vessels.

**Testing of soluble chloride ion content shall be carried out at least on each component, once per 200m<sup>2</sup> and a minimum of three times per shift during the progress of work. Special attention shall be given to areas where water has been trapped and dried out.**

The blast cleaned surface shall be rendered dust free and coated with the specified primer as soon as possible to avoid formation of oxidation on the surface, but **in any case within four hours from the time of blasting**, and at least one hour prior to sunset on the same day. Any steel surface not primed within these limits or that is wet shall be re-blasted.

No acid washes or other cleaning solutions or solvents shall be used on metal surfaces after they are blasted. This includes washes intended to prevent rusting.

All areas around the intended paint surface shall be cleaned of sand prior to coating. Drains shall be purged of sand and flushed.

Biodegradable water – soluble cleaning solution used to clean previously painted surfaces shall not lift softens or otherwise damages the existing coating.

**6.5 Blasting Equipment**

**6.5.1 Compressed Air**

The air compressor shall be capable of maintaining a minimum of 700 kpa (7 kg/cm<sup>2</sup> or 100 psi) air pressure at each blasting nozzle.

The compressed air supply shall be free of water and oil. Adequate separators and traps shall be provided on the equipment, which shall be regularly purged of water and oil to maintain efficiency.

**6.5.2 Nozzle**


The nozzle shall be a 10 mm (maximum) internal diameter venture style nozzle.

**6.5.3 Power Tools (Use can be permitted with specific approval for specific location)**

Power tools may be used to obtain a metal surface finish as per SSPC SP11 where blasting is not possible, or on items which might be damaged by blasting.

**6.5.4 Shot Blasting Equipment**

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Shot blasting equipment may be used for specific applications. Shot shall be changed as required to maintain the angular profile requirement.

6.6 Blasting Abrasive

6.6.1 Abrasive

The abrasive shall be as per SSPC-AB-1. The abrasives shall be copper slag, steel balls, garnet or coal slag and shall be free of contamination of dust and chlorides to produce the required anchor profile and graded as to be free from clay, silt or other matter likely to become embedded in the steel surface. Abrasives which have a tendency to shatter and adhere or embed in the steel surface shall not be acceptable. Recycled abrasive shall not be used. Use of silica sand is not permitted.

6.6.2 Shot Blasting Material

Shot blasting material shall pass through a 16 mesh screen. At least 15% steel grit shall be mixed with the graded shot to remove any rust, scale or other impurities pined into the surface by the shot. Shot blasting material is limited to iron, steel or synthetic shot which is applied by compressed air nozzles or centrifugal wheels. Shot blasting material shall be checked at least two times a week for replacement of abraded material.

6.6.3 Alternative methods of Surface Preparation

a) For Blast Cleaning

Power Tool Cleaning shall be confined to minor areas.


Unless otherwise specified it shall be carried out in accordance with the requirement of ISO 5404-3. Power Tool Cleaning (grinding) to bare metal shall be done in accordance with SSPC SP-11.

If Power Tool Cleaning is not feasible the surface cleanliness shall as a minimum, meet visual standard PSt3 in accordance with ISO 8501-2 at the time of coating. Care shall be taken to ensure that Power Tool Cleaning does not polish the steel surface. Hand tool cleaning is permitted prior to Power Tool Cleaning. If the surface being prepared lies adjacent to a coated surface the Power Tool Cleaning shall overlap the coated surface at least by 25 mm and the coated surface shall be feathered.

b) Centrifugal Abrasive Blasting: [Applicable for all local / field splice for structural & Piping Items]

A portable blasting machine using recyclable steel abrasive may be used to prepare steel decks and tank floors.

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c) Vacuum Blasting

Vacuum Blasting may be used for spot repair of damaged or corroded area. It may be used in locations where open abrasive blasting is not permitted or desirable.

d) Wet abrasive blasting

Wet abrasive blast cleaning techniques may be used to avoid dust or in cases where fire and/or explosion risks are present. The cleaned surface should be washed off immediately after blast cleaning using fresh water. Corrosion inhibitors should not be used or only after written approval of the Principal. Corrosion inhibitor such as mass fraction 0.3 % sodium nitrite with mass fraction 1.2 % ammonium phosphate may be used to prevent flush rust, but Chromate inhibitors shall not be used. Corrosion inhibitor shall not be discarded into the sea. The paint Manufacturer shall approve the use of any inhibitor and the method for removing inhibitor residues before painting. The cleaned surface shall be dry at the time of painting. Particular care shall be taken to dry areas which are not self-draining, so that water collected is removed.

e) Water Jetting

High-pressure and ultrahigh-pressure water jetting may be used where abrasive blasting is not permitted because of the risk of damage to process equipment. Water jetting is restricted to maintenance painting. It is a hazardous operation and requires the use of well-trained, experienced operators. Where black spots occur in pits or other surface defects, the surface shall be cleaned again at higher pressure to remove the residual salts. Corrosion inhibitors should not be used or only after written approval of the Principal. Corrosion inhibitor such as mass fraction 0.3 % sodium nitrite with mass fraction 1.2 % ammonium phosphate may be used to prevent rust flash, but Chromate inhibitors shall not be used. Corrosion inhibitor shall not be discarded into the sea. The paint Manufacturer shall approve the use of any inhibitor and the method for removing inhibitor residues before painting.

The cleaned surface shall be thoroughly dry at the time of painting. Particular care shall be taken to dry areas which are not self-draining, so that water collected is removed.

## 7.0 COATING APPLICATION


### 7.1 General Application

All application, inspection and safety procedures shall be carried out in accordance with SSPC Painting Manuals, Vol. 1 Chapter 14.2 and Vol. 2 Chapter 5) and as set out below.

#### 7.1.1 Supply and Storage


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<p>All coatings shall be furnished, mixed and applied in accordance with manufacturer's recommendations and as specified herein. Mixing of different manufacturer's coating applications on the same surface is not permitted.</p> <p>All coating materials and thinners shall be in original, unopened containers being the manufacturers label batch numbers and instructions. For materials having a limited shelf life, the date of manufacture and the length of life shall be shown. Materials older than their stated shelf life shall not be used.</p> <p>Materials shall be stored in accordance with the manufacturer's recommendations.</p> <p>Coating materials that have gelled, other than thixotropic materials or materials that have deteriorated during storage shall not be used.</p>											
<b>7.1.2 Pot Life</b>											
<p>If the coating requires the addition of a catalyst, the manufacturer's recommended pot life for the application conditions shall not be exceeded. When the pot life is reached, the spray pot shall be emptied, cleaned and a new material catalyzed. Manufacturer's recommendations to be followed</p>											
<b>7.1.3 Mixing</b>											
<p>Mixing and thinning directions as furnished by the manufacturer shall be followed. Only thinners specified by the manufacturer shall be used.</p> <p>All coating materials shall be stirred with a power mixer use, until the pigments, vehicles and catalysts are thoroughly mixed and then strained while being poured into the spray pot. During application the materials shall be agitated according to the manufacturer's recommendations.</p> <p>Different brands or types of paints shall not be intermixed.</p>											
<b>7.1.4 Unblasted Surfaces</b>											
<p>Coating shall not be applied within 75 mm of an unblasted surface.</p> <p>A 300 mm wide strip of uncoated, blasted surface shall be left between primed and unblasted surfaces, so as to prevent damage to the newly dried coating when additional blasting is done.</p>											
<b>7.1.5 Application Requirements</b>											
<p>A Coating procedure test (CPT) shall be used to qualify all coating procedures. A suitable location on the component to be coated may be selected on which the CPT shall be carried</p>											

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out. Alternatively, a test panel (minimum 1 m x 1 m) containing at least 1 pipe-end (1500mm long& 50 mm Ø., 1 angle and 1 flat bar (1500 mm in length)may be used for other coating systems. The coating procedures shall be qualified under realistic conditions likely to be present during coating. Selection of coating systems and application procedures shall be made with due consideration to conditions during fabrication, installation and service of the installation.

## 7.2 Cleanliness

All Surfaces shall be clean free from dust and dry. Any blast cleaning dust or grit remaining on the surfaces shall be removed by means of compressed air before priming or application of any coating. Any surface with a rust bloom shall be re-blasted as per ISO: 8504.

### 7.2.1 Temperature

**Coating shall only be applied when the temperature of the steel is at least 3°C above the dew point,** ambient air temperature must be within the limits specified by the manufacturer.

### 7.2.2 Weather Conditions

**No coatings shall be applied during fog, mist or rain or when humidity is greater than 85% or on to wet surfaces.** In case the minimum temperature at the fabrication yard is below 5°C, the contractor shall propose alternate coating procedure for Company's approval at the bidding stage itself.

The company has the right to suspend application of coating when damage to the coating may result from actual or impending weather condition.

When Relative Humidity (RH) is less than 60%, Zinc rich Epoxy Primer shall be used in instead of Inorganic Zinc Silicate as per recommendation of manufacturer and with prior approval of the company.


### 7.2.3 Coats

Each coat shall be applied uniformly and completely over the entire surface. Each coat shall be allowed to dry for the time specified by the manufacturer before the application or a succeeding coat. To reduce the possibility of intercoat contamination and to assure proper adhesion between successive coats, all coats shall be applied as soon as possible after the minimum specified drying time of the preceding coat.

## 7.3 Brush Application

### 7.3.1 General Requirements

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A **stripe coat** shall always be applied by brush. The stripe coat shall be applied for each coat to all edges, corners, welding seams, bolt holes, back side of piping, stiffeners, vent and drain holes, notches and any other area that is difficult to reach by spray gun & where spraying may not be effective.

The colour of the stripe coat shall be different from the previous or subsequent coat.

Inorganic zinc primer coatings shall not be applied by brushing, not even for touch – up repairs.

7.3.2 Equipment for Brush Application

Brushes shall be of a style and quality that will permit proper application of coating. 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. Brush width shall not be greater than 100 mm. No extension handles shall be used on brushes.

7.3.3 Procedure for Brush Application

Rounding of Edges and surface preparation shall be done as per Clause No. 6.3.1 of this Specification prior to brush application.

(a) Brushing shall be done so that a smooth coat, uniform in thickness, is obtained. There shall be no deep or detrimental brush marks.

(b) Paint shall be worked into all crevices and corners.

(c) All runs and sags shall be brushed out to prevent air pockets, solvent bubbles or voids.

(d) When applying solvent type, coatings, care shall be taken to prevent lifting of previous coats.

7.3.4 Finish Coat


An additional layer of finish coat shall be hand brushed at edges, corners, welds and hard-to-spray areas to eliminate holidays in the final coats.

7.4 Spray Application

7.4.1 Equipment

(a) All equipment to be used for spray applications shall be inspected and tested before application begins.

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(b) All equipment shall be maintained in good working order and shall be equal to that described in the manufacturer’s instructions.

(c) All equipment shall be thoroughly cleaned before and after each use and before adding new material.

(d) An adequate moisture trap shall be installed between the air supply and each pressure pot. The trap shall be of the type that will continuously bleed off any water or oil from the air supply.

(e) Suitable pressure regulators and gauges shall be provided for both the air supply to the pressure pot and the air supply to the spray gun. Spray equipment and operating pressures shall comply with the recommendations of the manufacturer.

(f) The length of hose between the pressure pot and spray gun shall not exceed 15 m.

7.4.2 Procedures

(a) Pressure pot, material hose and spray gun shall be kept at the same elevation where possible. When spraying inorganic zinc, the elevation difference shall not exceed 3m.

(b) The spray gun shall be held at right angles to the surface.

(c) Each pass with the spray gun shall overlap the previous pass by 50%.

(d) The spray width shall not exceed 300 mm.

(e) All runs and sags shall be immediately brushed out or the surface re-coated.

(f) Large surfaces shall receive two passes (except when applying inorganic zinc) at right angles to each other (crosshatched).


(g) The coated surface shall be checked for chloride contamination before application of subsequent coating. When surface are encountered with chloride contamination soluble salt removers shall be used before application of coatings.

7.4.3 Airless Spray Equipment

(a) Airless spray equipment may be used for applying epoxy or aliphatic polyurethane coatings.

(b) The manufacturer’s recommendations in selection and use of airless spray equipment shall be followed

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7.4.4 Field Welds

No coating shall be applied within 150 mm of edges prepared neither for field welds nor to surfaces waiting non-destructive testing.

7.4.5 Tie/Sealer Coat

After application of Inorganic zinc Silicate primer, a tie/sealer coat of 25-35  $\mu$ m DFT of polyamide epoxy on top of Primer coat shall be applied in order to seal porous surface of the zinc primer as per recommendation of the Manufacturer.

**7.5 Roller Application**

Roller application is permitted for paint materials where this is the manufacture's recommended method of application, such as for deck paints containing non-skid material. The manufacturer's recommended procedures shall be used.

**7.6 Over spray and Drip Protection**

Appropriate protection of buildings, structures and equipment from drips and spray and shall be provided to all equipment and facilities.

**7.7 Safety Equipment**

Appropriate safety equipment shall be provided for blasters, painters and other workers involved in the preparation and application of coating systems as per recommendation of paint manufacturer. Work areas shall be adequately ventilated.

**7.8 Handling and shipping of coated items**

Coated items shall be carefully handled to avoid damage to coated surfaces. No handling shall be performed before the coating system is cured to an acceptable level. Packing, handling and storage facilities shall be of non-metallic type.


**8.0 REPAIR OF DAMAGED AREAS**

All areas of paintwork that are locally damaged during transportation, handling or erection shall be repaired as specified below:

Prior to the application of any re-coat, damaged coatings shall be removed, preparing the surface and reapplying the protective coat(s).

Following steps of repair shall be followed for damaged painted / coated areas.

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### 8.1 Repair Procedure for Damaged coating

Surfaces where coating is damaged after application of the finish coat shall be repaired as follows;

#### 8.1.1 Top Coat

The top coat damaged, but base coat undamaged and the metal substrate is not exposed:

- (a) Damaged coating shall be removed with a hand file and abraded back to the sound coating using emery paper or a fine grinder.
- (b) The damaged area shall be wiped with a suitable solvent to remove debris. The periphery of repair area shall be feathered back for a minimum distance of 25 mm into the adjacent undamaged coating by light abrasion or grinding to produce a smooth chamfered surface profile.
- (c) Apply a new topcoat as specified.

#### 8.1.2 Base Coat

Coating damaged to base metal


- (a) The damaged area greater than 0.2m<sup>2</sup> in area, the surface of exposed metal shall be prepared to the original specified standard prior to repairing by power tool cleaning as per SSPC-SP3 or spot blasting to SSPC-SP5 and applying primer, intermediate coat and final coat as specified. Alternatively, high solid surface tolerant epoxy coating may be used in place of primer & intermediate coats, followed by specified topcoat
- (b) The damaged areas less than 0.2 m<sup>2</sup> in area may be repaired as per manufacturer's recommendation or by preparing the surface of exposed metal by power tool cleaning as per SSPC-SP11 to the original specified standard.

A primer, intermediate and final coat shall be applied as specified. Alternatively, high solid surface tolerant epoxy coating may be used in place of primer & intermediate coats, followed by specified topcoat. Brush application is acceptable. Even appearance and smooth feathering into surrounding coating in addition to correct dry film thickness and holidays must be achieved. Coating and surrounding repaired areas shall not be damaged and complete tie-in of the coating with surrounding areas shall be obtained. Zinc based products shall not be applied without Blast Cleaning to Sa 2 ½, instead Surface tolerant epoxy @ 100 microns shall be used as a primer in case blast cleaning is not possible or practical.

### 9.0 GALVANIZING

#### 9.1 Galvanizing Standard

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All steel grating, stair treads, handrails, ladders and other items specified as being galvanized shall be hot-dipped after fabrication in accordance with ASTM A123. Iron and steel hardware materials shall be hot-dip galvanized in accordance with ASTM A153.

9.2 Surface Preparation

All welding slag and burrs shall be removed. Surface contaminants and coatings, which cannot be removed by the normal chemical cleaning process in the galvanizing operation, shall be removed by abrasive blast cleaning.

Steelwork shall be prepared in accordance with the requirements of ASTM A123 and/or ASTM A153.

9.3 Zinc Coating Weight

The weight of zinc coating on structural items shall be **minimum 0.705 kg/m<sup>2</sup>** surface area. The composition of the zinc used in the galvanizing bath shall not be less than 98% zinc.

9.4 Surface Finish

The galvanized coating shall be continuous, adherent, as smooth and as evenly distributed as possible and free from any defect that is detrimental to the end use of the coated component. On 'silicon killed' steels, the coating may be dully gray, provided the coating is sound and continuous.

9.5 Welding

Galvanized members, that are to be permanently fixed by welding, shall be attached after the supporting members are primed, but before topcoats are applied. The heat affected area of the supporting structure shall be cleaned of all welding flux, the surface prepared and the coating reinstated. Grinding of edges prior to welding shall be permitted to reduce zinc oxide fumes formed during welding and eliminate the potential for weld porosity to occur. Adequate ventilation shall be provided and in confined spaces a respirator shall be used.


9.6 Damaged Items

All damage to galvanized items caused by fabrication, welding, handling and loading out of installation shall be reinstated.

9.7 Reinstatement of Damaged Surfaces

Repaired surfaces shall present the same appearance as adjacent galvanized areas and have approximately the same weathering characteristics as the galvanized surface.

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9.8 Painting Galvanized Surfaces

All galvanized structural members shall be painted with coating system **13.7**. All galvanized surfaces shall be degreased, fresh water washed and treated as per SSPC SP1. It will then be sweep blasted and coated with surface tolerant epoxy – F8 as primer or compatible Epoxy primer followed by respective coating systems.

9.9 Painting Aluminium Helideck

**a) For Blast Cleaning**

All areas to be thoroughly cleaned with strong detergents and high pressure water to remove all traces of oil or grease. Aluminum oxide to be used as blasting media, abrasive size to be 60-80 mesh, surface profile 25-50 micron. Nozzle pressure to be 4-5 bars. During blasting nozzle movement should be continuous to avoid positional high density as aluminum is a soft metal.

For spot repairs after painting no spot blasting is recommended, positional rectification by mechanical tool cleaning shall be done. Part by part blasting and priming is preferable than one time area blasting and priming as it is difficult to identify oxidation over aluminum surface.

**b) For Power Tool Cleaning**

All areas to be thoroughly cleaned with strong detergents and high pressure water to remove all traces of oil or grease. 3M abrasive flap of 35or 60 meshes for electrical or pneumatic rotor grinding machine to be used for roughening the surface. It is preferable to prime the surface within 4-5 hours after cleaning to avoid oxidation over cleaned surface. Part by part blasting and priming is preferable than one time area blasting and priming as it is difficult to identify oxidation over aluminum surface.

9.10 Painting stainless steel (wherever applicable):

Stainless steel Handrails and ladders in the splash zone as specified in bid shall be coated as under:

i.

Surface preparation: Sweep blasting with non-metallic and chloride free grit to obtain anchor profile of approximately 25 µm to 50 µm.

ii.


Top coat: Two component epoxy- minimum 350µm DFT.

Also as per recommendation of paint manufacturer.

**10.0 INSPECTION AND TESTING PLAN (ITP)**

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## 10.1 Quality Control

Procedures for testing and documenting quality control shall be prepared prior to the initial start up of any work covered by this specification & submitted to company for approval. The procedures shall include methods to assure the specification requirements are complied. Further, environmental conditions, surface temperature, coating applicator, surface(s) being coated and coating applied and status of required examinations and tests shall be documented.

Testing and inspection shall be carried out in accordance with Table-10.2. Surfaces shall be accessible until final inspection is carried out.

ITP shall include breakup of various activities, estimated time, duration for each activity. Time duration for painting activity wise is to be included in the in the planning package of the fabrication yard and adhere to the painting schedule during fabrication of structure in the yard.

Following inspection activities shall be included in the Inspection and Test Plan (ITP) furnished in Table 10.2.

## 10.2 Inspection and Testing requirements


Requirement for Inspection & Test Plan for Equipment, Pressure Vessels and Package items shall be followed as specified in respective Discipline Design Criteria or Specification

**Table 10.2.1 - Inspection and testing requirement**

Test type	Test Method	Test Frequency	Acceptance criteria	Consequence
Environmental conditions	Ambient and steel Temperature. Relative Humidity. Dew point.	Before start of each shift + minimum twice per Shift.	In accordance with specified requirements	No blasting or coating
Visual examination	Visual for sharp edges weld spatter slivers, rust grade, etc.	100 % of all surfaces	No defects, see specified requirements	Defects to be repaired
Cleanliness	a) ISO 8501-1 b) ISO 8502-3	a) 100 % visual of all surfaces b) Spot checks	a) In accordance with specified Requirements b) Maximum quantity and size rating 2	a) Re-blasting b) Re-cleaning and retesting until acceptable
Salt test	ISO 8502-6 and ISO 8502-9	Spot checks	Maximum conductivity Corresponding to 20 mg/m <sup>2</sup> NaCl for External surface and 50mg/m <sup>2</sup> for internal surface of Vessel.	Repeated washing with potable water and retesting until acceptable
Roughness	Comparator or stylus instrument (see ISO 8503)	Each component or once per 200 m <sup>2</sup>	As specified	Re-blasting
Curing test (for Zn silicate).	ASTM D4752	Each component or once per 100 m <sup>2</sup>	Rating 4-5	Allow to cure
Visual examination of coating	Visual to determine curing, contamination, solvent retention, pinholes / popping, sagging and surface defects	100 % of surface after each coat	According to specified requirements	Repair of defects
Holiday	NACE RP0188 and as per note -1 below	As per coating	No holidays	Repair and retesting.

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detection		system specification		
Film thickness	ISO 19840. Calibration on a smooth surface	ISO 19840	ISO 19840, and coating system data sheet	Repair, additional coats or recoating as appropriate
Adhesion	ISO 4624 using equipment with an automatic centred pulling force, and carried out when coating system are fully cured	Each component or once per 200 m <sup>2</sup>	*See note-2 below	Coating to be rejected
Paint Material Inspection	Company appointed Inspector / representative shall physically verify paint material with respect to Test Certificate, data sheet, Batch Number, Date of Manufacture, date of expire and accept the Paint material.			
Surface preparation & Priming Coat application	Company appointed Inspector/ representative shall physically verify & record the surface preparation anchor pattern, record of surface salt acceptability and clear for priming coat application. Record of Temperature, Humidity and Dew point Temperature shall be recorded at the time of Start, at time interval Duration of Priming coating application and at completion time.			
Application intermediate coating	Company appointed Inspector/ representative shall carryout physical verification of coating application at random.			
Final coating application	Company appointed Inspector/ representative shall carryout physical verification of coating application at random.			
Final coating acceptance	Company appointed Inspector/ representative shall physically verify & record coating thickness, other field test and accept the coating.			

**\*Note:**

- Holiday Testing (Detection of pinholes)**

Holiday testing shall be conducted in accordance with NACE SP0188. For immersion and splash zone services, 100% of the coated areas shall be inspected for holidays. For atmospheric services, 10% of the coated areas, which include weld seams, corners, and edges, shall be holiday detected. Any holiday is unacceptable and shall be marked and repaired according to spot repair procedures. Lined vessel shall be marked clearly in black letters on vessel surface: "LINED VESSEL - HOT WORK PROHIBITED".


Pinhole testing for electrically non-conductive coatings shall be carried out in accordance with NACE RP0188 for splash zone coatings, internal tank coatings and the external coatings of buried tanks, vessels and piping. The high voltage technique shall be used; nominally set at 5 V/μm based on NDFT, or as agreed with the paint Manufacturer but not exceeding 25 kV in total. For coatings that are < 500 μm DFT, the wet sponge technique may be used if approved by the company.
- Adhesion test**

Adhesion test shall be carried out on separate test plates, adhesion values in accordance with ISO 4624 shall be minimum 5.0 MPa when using automatically centered test equipment.

**10.3 Role of Paint Vendor Representative**

The Contractor shall have to ensure that the Authorized technical-representative of the paint Manufacturer shall be qualified in accordance with NS 476 Inspector level II or certified as NACE coating inspector level II and physically inspects the painting / coating applications including surface preparation.

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The Authorized technical representative of the paint Manufacturer shall have relevant knowledge of health and safety hazard, use of protection equipment, coating materials, mixing and thinning of coatings, coating pot-life, surface requirements, etc.

Paint manufacturers inspector /supervisor present in the fabrication yard shall be qualified according to NS 476 Inspector level-I, or certified as NACE coating inspector level-I and may carry out the inspection work under the guidance of an inspector level-II.

**10.4 Qualification of Contractor’s QC personnel at Fabrication Yard (Inspectors, supervisors, foremen)**

The contractor’s quality control inspector shall be qualified as a coating inspector in accordance with NS 476 Inspector level II or NACE level-II.

The contractor’s quality control inspector shall qualify the tradesman level as blast-cleaner, painter, and applicator etc. for painting application.

The personnel shall have relevant knowledge of health and safety hazard, use of protection equipment, coating materials, mixing and thinning of coatings, coating pot-life, surface requirements etc.

Contractor shall carry out tests in accordance with the painting Specification, relevant Codes & standards for all coating systems applied as per clause 13.0 that are planned to be used for this project before commencement of painting work.

Contractor shall generate Painting application document & inspection report item wise specifying date & time of application for each step of painting with test record.

The test shall be carried out on a test panel in compliance to ISO 4624.


The acceptance criteria are the requirement to the visual and non – destructive inspection of the coating system described in this specification # section 10.2. Operators failing to meet the requirement shall not be allowed to carry out the work on this project.

**10.5 Qualification of passive fire protection operators**

Operators including pump machine operator, shall be qualified, trained and certified according to the manufacturer’s procedures. Before any stud welding, the welders and the procedures to be used shall be qualified in accordance with the coating manufacturer’s procedures.

If the operators or stud welders have not been working with the type of application or material within a period of 12 months, the applicator shall document that necessary supplementary training have been given before start of any work.

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10.6 Equipment and Material

Materials, tools or equipment used in the surface preparation and coating applications, shall be inspected regularly and rejected if they do not comply with the Specification.

10.7 Inspection of Instruments

The following items shall be inspected using the inspection instruments listed below:

Instrument Item	Inspection Instrument
Surface Profile	Keane-tator Surface Profile Comparator or Testex Press-o-Film Elcometer 124 with 122 testex tape
Holidays	Tinker – Razor Model M – 1
Surface Cleanliness	SSPC – Vis – 1
Viscosity	Zahn Viscometer or Ford Cup
Wet Film Thickness(WFT)	Nordson Wet Film Thickness Gauge Sheen WFT Gauge
Temperature & Humidity	Gardner Certified Hydrometer and Temperature Indicator
Surface Temperature	Pandux Surface Temperature Thermometer Elcometer Surface temperature gauge
Compressed Air Quality	Dry white cloth

10.7.1 Calibration of Equipment

Each test instrument shall be maintained and calibrated as prescribed by the manufacturer.

10.7.2 Dry Film Thickness

The dry film thickness of the coating system shall be determined in accordance with SSPC-PA2 or by a Microtest thickness gauge (ISO 2178) or comparable instrument in accordance with the following procedure.

(a) Ten readings shall be taken for every 10m<sup>3</sup> of painted areas.


(b) 90% of all readings shall be within the specified dry film thickness.

(c) Where thickness accordance with the above procedure fall below the specified minimum an additional coat of the intermediate or finish coat shall be applied.

10.8 Repair

All work not done in accordance with this specification shall be redone or repaired as per coating system 13.10.

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### 10.9 Maintenance

For maintenance of previously coated surfaces, the condition of the existing coating and the surfaces shall be checked using suitable methods, e.g. ISO 4628, to determine whether partial or complete repainting should be carried out. The type of surface preparation and protective paint system shall then be specified. The paint manufacturer should be consulted for recommendations. Test areas may be prepared to check the manufacturer's recommendations. Coating system 13.11 shall be followed for maintenance work.

### 10.10 Role of Company Representative / Company appointed TPI /CA

Refer Table 10.2

### 10.11 Surface preparation, Coating application & field Test Report


- Contractor shall generate Painting application & inspection report item wise (to be painted) for each activity of painting (surface preparation, priming, tie coat, 1<sup>st</sup> coat & final coat as applicable) specifying date & time of application. A daily record shall be maintained with following as minimum:
  - (a) Air Temperature at the start, finish of the work and at intermediate stage.
  - (b) Relative Humidity & dew point during application period (at interval of time).
  - (c) surface roughness/ anchor profile,
  - (d) Coating Material details & batch number (for traceability),
  - (e) Salt test, chloride contamination
  - (f) Dry film thickness applied & Identification of areas coated
  - (g) Results of required field tests carried out.
  - (h) Paint progress/ time lapse between coats.

These reports generated shall be documented in Construction Dossier in original and submitted to Company with PDF Copy.

### 11.0 PAINT MATERIALS:

The coating manufacturer shall provide a Coating System Data Sheet (CSDS) for each coating system to be used, containing at least the following information for each of the primer, intermediate coat (s) and topcoat product:

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<ul style="list-style-type: none"> <li>• Product name</li> <li>• Colour</li> <li>• Material type</li> <li>• Batch numbers, Part A &amp; B</li> <li>• Manufacturing Date</li> <li>• Shelf life</li> <li>• Volatile organic compounds (VOCs) (g/l)</li> <li>• Cleaning Solvent</li> <li>• Thinner Type</li> <li>• Maximum percentage of thinner content by volume</li> <li>• Mixing ratio by volume or weight</li> <li>• Application method</li> <li>• Application temperature range (°C)</li> <li>• Application RH range (%)</li> <li>• Induction time (minutes)</li> <li>• Minimum recoat and dry to touch time (hours@ temperature)</li> <li>• Maximum recoat time (days @temperature)</li> <li>• Solids content by weight and/or volume</li> <li>• WFT Range (µm)</li> <li>• DFT Range (µm)</li> <li>• Pot life (hours@ temperature)</li> </ul>												

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Paint manufacturer shall furnish all the characteristics of paint materials on printed literature, along with the **test Certificate with actual test values of supplied batch for all the specified characteristics given in the specifications.**


Paint Material inward & traceability (location used) shall be maintained. These records shall be documented in Construction Dossier and submitted to Company.

All the paint materials shall be of first quality and conform to the following general characteristics are furnished below:

**Table -11.1: Required Characteristic of Paint Materials**

Description	Technical name	Type and composition	Volume of solids (approx.)	DFT (Dry film thickness) per coat (approx.)	Theoretical covering capacity in M <sup>2</sup> /coat/litre (approx.)	Weight per litre in kgs/litre (approx.)	Touch dry at 25° C (approx.)	Hard dry at 25° C (approx.)	Over coating interval (approx.)	Pot life (approx.) 25° C	Resistance to dry temperature
1	2	3	4	5	6	7	8	9	10	11	12
F-1	Epoxy MIO High build finish paint	Two pack polyamide cured epoxy, pigmented with lamellar micaceous iron oxide	80 ± 5%	100-125u	As per suppliers data	1.4	3 hours	Overnight	Min. : Overnight Max. : as recommended by manufacturer	2 hrs.	90°-120°C
F-2	Self-priming surface tolerant High build Epoxy coating	Two pack epoxy resin based suitably pigmented	80 ± 5%	100-125u	As per suppliers data	1.4	3 hours	24 hours	Min. : 10 hours Max. : as recommended by manufacturer	90 mints	90°-120°C
F-3	Inorganic zinc-silicate coating SSPC SP-20, Level-II, containing 80±3% zinc in dry film by weight & zinc as per ASTM D520 Type-II	A two pack air drying self-curing solvent based Inorganic Zinc silicate coating.	65 ± 5%	65-75u	8-9	2.3	30 mts	less than 6 hours	Min. 16-24 hours Max. : as recommended by manufacturer	2 to 4 hours	400°C
F-4	Organic zinc rich epoxy coating SSPC SP-20, Level-II, containing 80±3% zinc in dry film by weight & Zinc as per ASTM D520 Type-II	Two pack epoxy resin based zinc primer	65 ± 5%	65-75u	As recommended by manufacturer	2.5	75 mts	less than 6 hours	Min. : 6 hours Max. : as recommended by manufacturer	5 hours	90-120°C
F-5	Heat resistant Aluminum paint based on Moisture Curing Silicone Binder	Single pack moisture cured silicon resin based medium with aluminum flakes	40±5%	20-25u	As recommended by manufacturer	1.1	30 mts	1-2 hours	Min. : 6-12 hours Max. : as recommended by manufacturer	Not applicable	Upto 600° C
F-6	Epoxy Phenolic based Tank Lining (see note-1)	Two Pack Epoxy Phenolic Based	60±5%	125 u-150µ	As per suppliers data	Min 1.4	5 hours	8 hours	Min. : 8 hours Max. : as recommended by manufacturer	As recommended by manufacturer	Upto 200°C
F-7	Epoxy Passive fire protection (PFP)		100%	As per risk analysis Study report & as recommended by manufacturer							
F-8	Extra High Build Epoxy	Two pack polyamide/Polyamine cured epoxy resin	100± 5%	2500 µm	As per suppliers data	Min 1.9	8 hours	Overnight	Min. 4 hrs Max. As recommended By manufacturer	30 minutes	140°C
F-9	Glossy Aliphatic Acrylic Polyurethane Topcoat	Two Components Aliphatic Acrylic Polyurethane	60±5%	65-80 µm	As per suppliers data	—	1.5 hours	6 hours	Min. 6 hours Max. : As per suppliers data	1 hour	90° -120°C
F-10	Solvent free epoxy for Drinking / potable water tanks (see note-2)	A Two pack solvent free epoxy tank coating for drinking water	100%	250-300µm	As per suppliers data	—	6 hrs	12 hrs	Min. : 10 hours Max. : 40 hours	1 hour	Upto 60°C
F-11	Ultra High Build glass flake Epoxy	A Two component glass flake Epoxy coating	96±2%	600-1000 µm	As per suppliers data	—	Refer Product Data Sheet	Refer Product Data Sheet	Refer Product Data Sheet	Refer Product Data Sheet	90-100 °C

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F-12	Pure epoxy pigmented with aluminium (see note-3)	A Two component Pure epoxy coating pigmented with aluminium	60%±2%	100-200 µm	As per suppliers data	---	3 hours	6 hours	7 hours -14 days	2.5 hours	---
F-13	Low volume solid epoxy primer As recommended by paint manufacturer	A Two pack epoxy solvent free epoxy tank coating for drinking water	47%±2%	40 µm	As per suppliers data	---	30 minutes	8 hours	As recommended by supplier	8 hours	--
F-14	Sealer coat TSAC As recommended by paint manufacturer	Used as Sealer for TSAC Operating temperature >120° C	30%	15-25 µm	--	---	20 minutes	2 hours	As recommended by supplier	--	--
F-15	One coat of fast curing solvent less UV -resistant polyester resin (isophthalic based reinforced with glass flakes.	Glass flake reinforced unsaturated Polyester coating	96%±2%	600-1500 µm	As per suppliers data	--	2 hours	2 hours	As recommended by supplier	45 minutes	90-100 °C

**Note:**

1. IMO PSPC COT Resolutions MSC. 288 (87)
2. APAS Approved to specification 0213, 2974F & 2974P / UL Certified in accordance to NSF/ANSI 61. [In case of water tank constructed using stainless steel SS316L, tank internal coating is not required.]
3. Approved for PSPC for water ballast tank according to IMO Res. MSC 215 (82)

## 12.0 APPROVED VENDOR'S RECOMMENDED LIST OF PAINT MATERIALS

Table-12.1: **Approved Vendor's** Paint products

Description	Area of application	Berger Paints Ltd., India	Shalimar Paints, India	Carboline, USA (CDC) Carboline, India	Sigma Coatings (PPG Coatings), USA	Hempel, Denmark	Amercoat (PPG Coatings), USA	Jotun Coatings, Norway / Jotun India Pvt Ltd	KCC Paints Corporation , Korea	International Brand (AKZO NOBEL), UK	Chogoku paints, Singapore	Excel India Paints, India
1		2	3	4	5	6	7	8	9	10	11	12
F-1 Epoxy MIO High Build finish	Exterior surface of steel <120° C	Epilux 455 HB MIO	epiguard XL	Carboguard 893 MIO	sigma cover 410 (MIO)	Hempadur Mastic 45880/1W / 47550	Amercolite 383 HS / 410 (MIO)	Penguard Midcoat MIO	Korepox EH2350	Interseal 547/ Interseal 475 HS	Univan MIO	EXL GUARD 495
F-2 Self-priming surface tolerant High build Epoxy	Maintenance Painting	Barger Protectomastic RPL	epiplus 56	Carbomastic 615	Sigma Cover 630 /620	Hempadur Mastic 45880/1W / 47550	amerlock 400 / 400C	Jotamastic 80/Jotaprime mastic 80	Korepox Primer EP 1760	Interseal 547/ Interseal 670 HS	Umeguard HS	EXL GUARD 680
F-3 Inorganic zinc silicate coating SSPC SP-20, Level-II, containing minimum 80% zinc in dry film by weight & zinc as per ASTM D520 Type-II	Primer coat Relative Humidity> 60%	Zinc anode 304 Coating	tuffcote silicate -I2S	cabozinc 11	Sigma Zinc 158	Hempel's Galvosi 15780	dimelcote 9	Resist 78/Resist 804A	Galvany IZ 180 (N)	Interzinc 2280	Galbon S-HB	EXLZINC 113
F-4 Organic zinc rich epoxy coating SSPC SP-20, Level-II, containing minimum 80% zinc in dry film by weight & Zinc as per ASTM D520 Type-II	Primer coat When Relative Humidity< 60% & Primer for repair work	Epilux ZR HB Primer	Epigard 4	Carbozinc 858	Sigma zinc 109 HS	Avantguard 1736 G series	Amercoat 68 HS	Barrier 80	Korepox Zinc Rich Primer EZ 175	Interzinc 52	-	EXLZINC 108
F-5 Heat resistant Aluminium paint based on Silicone Binder	Temperature >400° C For equipments	Lumerous HR143	lustotherm 600	Thermaline 4700 aluminium	Sigmathe rm540	Hempel's Silicon aluminium 56914	Amercoat 878 HS	Solvalitt	Yeolcoat QT 606	Intertherm 50	-	EXLTHERM HR600
F-6 Epoxy Phenolic based Tank Lining	Internal lining of Diesel & crude oil tank	Epilux 9 HB Phenolic Coating	HB finish	Phenoline 187 VOC	sigma guard 730	hempadur 85671	Amercoat 90 HS	Tankguard storage	Kophenol EH2630	Interline 850	-	EXLLINE 965
*F-7 Epoxy (PPP) (See note-2 below)	Protection of platform from pool and jet fire	-	-	Pyroclad X1	PITT-CHAR XP	Hempafire Pool 200	PITT-CHAR XP	Jotachar JF 750/Jotachar 1709	Firemask 3200	Chartek-7/ Chartek-7E/ Chartek-1709	-	-

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F-8 Extra High Build Epoxy	Steel plated helideck, walkway , escape route & laydown area			Carboguard 1207	Sigmashi eld 1090	Hempel's Spray Guard 35490/3	Tideguard 171	Jotacote UHB	Korepox H.S.EH3200	Interzone 485		EXL GUARD- 991UHB
F-9 Glossy Aliphatic Acrylic Polyurethane Topcoat	Finish coat for UV protection & required colour	Bergerthane Acrylic PU Coating	Shalthan e HB rich	Carbothane 134HG	Sigmash 550 / 585	Hempathane topcoat 55910/55610/ 55210	Amercoat 450 Series	Hardtop XP/Futura OS	Korethan Topcoat UT6581	Interthane 990/ Interthane 990 SG		EXLTHANE 570
F-10 Solvent free Epoxy	Internal lining of potable water tank	Epilux 155 SF	-	Carboguard 703	Sigma Guard CSF 650 / 585	Hempadur 35530/35531	Amercoat 391 PC	Tankguard 412	Korepox H.B.EH3100	Interline 925		EXLLINE- 989SF
F-11 Ultra High Build glass flake Epoxy (Splash Zone)	Protection of structure in splash zone	Steel shield 1100	Tuffkote Epishield ST glass flake epoxy	Carboguard 1209	Sigmashi eld 905 / 880GF	Hempadur Multistrength 35870	Amerlock 400GF	Marathon XHB	Korepox H.B.EH3200 (GF)	Interzone 1016	Permax no 3000 S	EXL GUARD- 890GF
F-12 Pure epoxy pigmented with aluminium	Internal lining of ballast water/ salt water tank			Carbomastic 615A	Sigmaco ver 280	Hempadur uniqu 47741/ 4774 D	Amercoat182 ZP	Jotacote universal alu./ Jotacote universal N10	Korepox EH2030	Intershield 300		EXL GUARD- 343
F-13 Low volume solid epoxy primer As recommended by paint manufacturer	Used as Sealer/ Tie coat for TSAC & Over Zinc silicate primer Operating temperature <120°C			Carboguard 8932P	Sigmaco ver 522/246	Hempadur 05990/ 15553/ 15570	Amercoat 182 ZP/71 TC	Penguard tie coat 100 /Penguard primer	Korepox Holding Primer EP 1700	Intergard 269		EXL GUARD- 247
F-14 Aluminum silicone sealer/tie coat As recommended by paint manufacturer	Used as Sealer for TSAC Operating temperature >120°C			Thermaline 1248 E	Sigmathe rm 540	Hempel's Silicon aluminium 56914	Amercoat 878	Penguard tie Coat 100/ Penguard primer		Intertherm 50/ Intertherm 972		EXL THERM- 530
F-15 Glass flake Polyester resin	Splash zone to bottom of Cellar deck (Maintenance Painting)	---	-----	-----	---	Hempel's Polyester GF - 35920	Amercoat - 4800	Baltoflake	-----	Interzone- 762	-----	---

### Note:

- The paint materials indicated in the table are indicative only and may be updated. Bidder is to select & procure latest paint material from the list of the recommended list of paint manufacturers meeting the DFT requirement of paint.
- \*Epoxy (PFP) installed on the platform shall be Tough, durable and resistant to impact and vibration damage. Thickness of coating shall be based on risk analysis study report and fire safety measures to be taken to mitigate hydrocarbon and jet fire as per ISO 22899 jet fire certification up to 2 hours and NORSOK M-501. FIRE RATING shall implement based on safety study carried out in compliance to API 14J & API RP 2A.
- Contractor to verify the latest status of availability & applicability of products before consideration and report their intention of change within the above listed vendors with proper reasons.

## 13.0 PROTECTIVE COATING SYSTEMS


### 13.1 SCOPE

Manufacturer's recommendations and latest product of paint shall be used to suit the environment conditions and for the intended purpose shall be followed. Care must be taken to achieve the specified dry film thickness indicated in the bid. **Items to be painted covered by these specifications are as follows:**

### 13.2 Section A: New Construction of offshore structure.

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**13.2.1 Coating System No.1:** Atmospheric Zone-I: Thermally sprayed aluminium coating shall be applied for items having service life of 10 years or longer which are :

13.2.1.1 exposed to seawater & not easily accessible for inspection or maintenance:-

- i) structural Steel items, piping .piping supports etc. **above splash zone** upto & including **Bottom plating of cellar deck**,
- ii) Conductors, Pump & Sump Caisson.
- iii) bottom framing beams & plating of Main Deck
- iv) bottom chord of Bridge including bottom of plating , piping .piping supports etc
- v) Boom of pedestal crane
- vi) Steel framing supporting helideck above main deck and upto and including bottom of steel helideck.

TSAC is not required for bottom of aluminium pancake.


13.2.1.2 Exposed to operating temperature > 120 °C as heat resistance paint.

- i) Flare Stack/vent boom

13.2.1.3 :Table for TSAC System

Application	Surface Preparation	Coating System	DFT
<b>Coating System No.1A</b> All carbon steel surfaces exposed to operating temperature > 120 °C. <ul style="list-style-type: none"><li>Flare Stack/vent boom.</li></ul>	Cleanliness: SSPC –SP5/ Sa 3 Surface Profile: Minimum 75 µm	Thermally sprayed Aluminium or alloys of aluminium with sealer coat as top coat. *Sealer: (F-14)	225 µm (Min value 200 µm & Max value 250 µm ) For sealer, see Note- 1
<b>Coating System No.1B</b> All carbon steel surfaces exposed to atmosphere & operating temperature < 120 °C. <ul style="list-style-type: none"><li>Jacket above splash zone up to and including Cellar Deck bottom surface including bottom of deck plating, primary &amp; secondary beams etc.</li><li>Main deck bottom surface including bottom of deck plating, primary &amp; secondary beams etc.</li><li>Bottom chord of bridge connecting offshore platforms including</li></ul>	Cleanliness: SSPC-SP5/ Sa 3 Surface Profile: Minimum 75 µm	Thermally sprayed aluminium or alloys of aluminium with sealer, intermediate coat and final coat as top coat  *Sealer: (F-13) *Intermediate Coat (F-1) *Final Coat(F-9)	225 µm (Min value 200 µm & Max value 250 µm ) See Note- 1 : Sealer Coat Note- 2: Intermediate Coat Note- 3: Final coat

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<div>bottom of deck plating<ul style="list-style-type: none"><li>Steel framing supporting helideck above main deck and upto bottom of helideck below aluminium pancake &amp; bottom of steel helideck plating</li><li>boom of pedestal crane</li></ul></div>				
<p>*Note-1: All metallized surfaces shall be sealed in accordance with the following requirements: The sealer shall fill the metal pores. It shall be applied until absorption is complete. There should not be a measurable overlay of sealer on the metallic coating after application.</p> <p>The materials for sealing the metal coating shall be:</p> <ul style="list-style-type: none"><li>Two-component epoxy for operating temperatures below 120 °C (F-13).</li><li>Aluminium silicone above 120 °C (F-14).</li></ul> <p>Volume solids in the sealers when applied shall be 15 % nominal. The overlay of sealer should be less than 38 µm (1.5 mil) on the TSA coating after application.</p> <p>The sealer should have a contrasting color to the TSA to aid visual inspection.</p> <p>*Note-2: Intermediate coat over TSAC shall be applied as per coating system no.2</p> <p>*Note -3: Final coat TSAC shall be applied as per coating system no.2</p> <p>Application of Thermally Spread Aluminium Coating (TSAC) is specified in Clause No. 14.0.</p> <ul style="list-style-type: none"><li>Repair, field coating of pipes and coating of in-fill steel</li></ul> <p>All requirements, including adhesion, applicable to metal spraying, shall apply.</p> <p>The treating and handling of the substrate shall be done in such a manner that the product in its final condition will have a continuous and uniform coating. Before the metal spraying operation starts, the area 30 cm to 40 cm in distance from the weld zone shall be sweep-blasted to ensure that all contamination is removed. The uncoated welding zone shall be blast Cleaned as specified for coating system no. 1.</p> <p><b>13.2.2 Coating System No.2: Atmospheric zone - II except for zone specified under coating system no. 1</b></p>				
Application Area	Surface Preparation	Coating System	Coating Range	DFT
Carbon steel with	Cleanliness:	Primer Coat: Inorganic zinc silicate	65 - 75 µm	

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operating temperature < 120 °C – Structural steel, Exteriors of equipment, vessels, piping and valves (not insulated) in Atmospheric Zone <b>except for zone specified under coating system no. 1</b>	Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS- 05-5900 /ISO 8501-1 surface profile : 40-60 µm Max.	primer (F-3)	
		Sealer Coat/tie coat: Low volume solid epoxy (F-13) as recommended by paint manufacturer	25 - 30 µm
		Intermediate coats: Two coat of high build epoxy (F-1) with MIO pigments	2 X 100 – 125 µm
		Finish Coat: One Topcoat of Gloss Aliphatic Acrylic Polyurethane (F- 9)	65 - 80 µm
		Total DFT µm	355-435 µm

### Notes:

1. This system is applicable for carbon steel surface with operating temperature less than 120° C.
2. Colour for final coat shall be as per colour code.

### 13.2.3 Coating System No.3: Protection of Carbon Steel in Submerged & Splash Zone

Application	Surface Preparation	Coating System	Coating DFT Range
Coating System No.3A: Submerged Zone • PLEM, SSIV and Riser clamps, etc.	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 Surface profile : 40-60 µm Max.	two coat epoxy based primer with aluminium pigment (F-12)	2 X 100- 125µm. Total 200 µm min.
Coating System No.3B: Splash zone: Jacket, Boat landing, Barge Bumper, conductors, Riser & Conductor Protector, clamps, etc.	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 Surface profile: 75-100 µm Max.	Two coats of Ultra High Build Glass Flake Epoxy Coating (F- 11)	2 X 750 µm. Total 1500 µm min.


### 13.2.4 Coating System No.4: Galvanizing

All grating, handrails, ladders, safety cages shall be hot dip galvanized as per ASTM 123 & misc. hardware shall be hot dip galvanized ASTM A153. Galvanizing shall preferably be done after cutting shaping and welding has been done. The weight of zinc coating for grating, handrails, ladders, safety cages shall be minimum **705 gm** per square meter (coating thickness of 100 µm).

The weight/thickness of zinc coating for iron and steel hardware shall be as per ASTM A153.

The galvanized surface shall be free from bare spots, Drass pimples, Lumpiness and runs, flux inclusions and slag inclusions.

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13.2.5 Coating System No.5: Painting of All Galvanized items except gratings & Aluminium Helideck shall coated as per #13.2.4

Application	Surface Preparation	Coating System	DFT in $\mu\text{m}$
All Galvanised items and Aluminium Helideck painting for marking, lettering, etc.	SSPC SP1 & etched chemically with etch primer or physically by sweep blast cleaning with non-metallic and chloride free grit to SSPC SP7/Sa1. Cleaning with alkaline solution followed by hosing with fresh water as per SSPC SP1. surface profile : 25-50 $\mu\text{m}$	Low volume solid epoxy primer suitable for aluminium & galvanized surface. (F-13)	Minimum 50 $\mu\text{m}$
		Intermediate coat: Two coat of high build epoxy with MIO pigments. (F- 1)	2 X 100 $\mu\text{m}$
		Finish Coat: One coat of aliphatic polyurethane. (F-9)	Minimum 75 $\mu\text{m}$
			Minimum DFT 325 $\mu\text{m}$

13.3 SECTION B: New Construction: Process vessels and piping, valves, manifolds, pumps, heat exchangers and related equipment

13.3.1 All submersible type pumps protective coating system shall be as per manufacturer's standard which shall be suitable for Marine environment. Holiday test shall be carried out on protective coatings of all equipment as per NACE SP 0188.

13.3.2 Piping & other equipment

For Piping & other equipment made up of Carbon Steel Material, Protective coating system shall be followed as per Clause No. 13.2.2.

13.3.3 Flanges

Flanges on equipment to be installed on offshore platforms shall be coated with the protective coating system given in 13.2.2 except for the seal surface. Care shall be taken to prevent damage of ring and gasket seal surface by covering during the blasting and coating. After the coating has cured, an anti-rust grease coating shall be applied to protect the seal surface. Apply a minimum dry film of an anti-rust grease coating as per MIL-C-161730 Amendment, 2, Grade 1 Qualified Products List.

A corrosion control material (such as inhibitor grease) should be installed correctly initially after the flange has been assembled on the offshore structure. The bolt holes and flange crevices shall be sealed off completely from the offshore corrosive environment.

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Commercially available viscous sealants, such as soft and low-molecular-weight polyolefin sealants or corrosion inhibitor greases, should be injected into the flange crevice. The sealants are very hydrophobic. A polymeric tape or SS tape should then be wrapped around the flange to enclose the flange crevice completely.

Petrolatum or wax tapes may be used for ambient to moderate temperature service applications in accordance with the product manufacturer's specification.

For maintenance, the entire flange should be overwrapped with a commercial petrolatum or wax tape, which is made of polyester felt impregnated with very hydrophobic petrolatum or wax to provide encapsulation against water. Visual inspection cannot be conducted without unwrapping the tape. However, the flange shall be wrapped again after the inspection. Tape shall be replaced if the encapsulation is broken.

All Painted Nut bolts used for flanged/bolted connection shall be protected from corrosion by providing Protective caps with inhibited grease as per recommendation of the vendor.

**13.4 SECTION C: COMPRESSORS, GAS TURBINES, GENERATORS, ENGINES, MOTORS, INSTRUMENTS AND PANEL BOARDS**

Equipment in covered/enclosed areas shall be coated as per Equipment manufacturer's standards coating suitable for **offshore environment** as specified in respective Specification wherever provided in Bid, otherwise Protective System given in 13.2.2 shall be followed.

All skid surfaces which can be cleaned by blasting shall be coated with one of the protective system given in 13.2.2. Protect critical moving parts, bearing surfaces, machined surfaces, nameplates, glass next to machinery, etc. from entrance of blasting dust and damage from blasting by masking with polyethylene sheeting and masking tape. Equipment in enclosed areas shall be protected with the same paint systems as for exterior surface. Panel boards shall be disassembled before cleaning and coating.

**13.4.1** When equipment manufacturer's coating is unsatisfactory and blast cleaning is not permissible. Clean and protect as follows:

- Remove coating by use of a paint and varnish remover.
- Surface preparation; solvent cleaning (SSPC-SPI) followed by power tool cleaning (SSPC-SP3 or St3) or of SIS-05-5900.
- One coat of (F-2) Self priming surface tolerant epoxy coating @ 125 Microns DFT/Coat minimum (maximum DFT-150 microns)

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d. Top Coat – 2 coats (F-1) High build epoxy MIO coating cured with Polyamide/polyamine hardener @ 125 microns DFT/Coat minimum (maximum DFT – 150 microns/coat) = 2 X 125 =250 microns.

e. Finish Coat- One Topcoat of (F- 9) Gloss Aliphatic Acrylic Polyurethane 60-80 micron dry film thickness

Total DFT: Minimum: 375 microns, Maximum: 450 microns.

13.4.2 When equipment manufacturer's shop primer is sound and blast cleaning is not permissible, clean and top coat as follows (where finish coat has to be done at the yard):

a. Surface preparation: Solvent cleaning (SSPC-SPI), followed by power tool cleaning (SSPC-SP) or St 3 of SIS-05-5900.

b. Apply one coat of (F-2) Self priming surface tolerant epoxy coating @ 125 Microns DFT/Coat minimum (maximum DFT-150 microns).

c. Top coat: as per 13.4.1 (d) above.

13.4.3 Painting System applicable for Equipment having surface temperature between 110°C (230°F) and 400° C (752°F), clean and protect as follows.

a. Surface Preparation: Near white metal shot/grit blasting as per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501 –1:2001 with a 40 – 60 microns anchor pattern. Items with metal to metal joints shall be seal welded prior to blasting and coating when possible or dismantled following all fittings and welding to obtain blasting and coating of the joint surfaces

b. Apply 1 coat inorganic zinc silicate primer coating (F-3) @ 65-75 Microns DFT minimum (maximum – 75 microns).

c. Apply 2 coats (F- 5) of Heat resistant silicon aluminum finish paint @ minimum 20 microns DFT per coat = 2 X 20 = 40 microns (maximum 2 X 25 = 50 microns).


Total DFT: 105 Microns minimum: 120 microns maximum.

**Note :** coating having operating temperature less than 120 degree shall be coated as specified in respective Discipline Spec.

13.4.4 Equipment with surface temperature above 400°C (752°F),

a. Surface Preparation: Near white metal shot/grit blasting as per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501 –1:2001 with a 40 – 60 microns anchor pattern. Items with metal to metal joints shall be seal welded prior to blasting and coating when possible or

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dismantled following all fittings and welding to obtain blasting and coating of the joint surfaces

**b. Apply 2-3 coats of Heat resistant silicon aluminium finish paint (F-5) (maximum 3 X 20 µm – 25 µm).**

Total DFT: 60 µm minimum: 75 µm maximum.

**13.5 SECTION D: Internal Surfaces of Tanks and Process Vessels/ Piping/SPM**

**13.5.1 Coating System No.6: Coating of Internal Surfaces of Tanks and Process Vessels/Piping/SPM**

Application	Surface Preparation	Coating System	DFT in µm
System No.6A: Salt Water Service (ballast tanks/internal sea water filled compartments)	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 Surface profile: 60-85µm Max.	*Two coats of Epoxy pigmented with aluminium (F-12) (See Note-3)	2 X 150 µm. Min DFT 300 µm.
System No.6B: Hydrocarbon Services: all internal surfaces of Welded tanks handling hydrocarbons/diesel.	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 Surface profile: 50-85µm Max.	*Two coats of Phanolic Epoxy (F-6) (See Note-1)	1 X 125 µm – 150 µm Min. DFT 250 µm.
System No.6C: Fresh Water Services: all internal surfaces of Welded tanks handling portable water having NSF Certificate	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 Surface profile: 50-85µm Max	Two coats of Solvent free Epoxy. (F-10) (See Note-2)	2 coat @ 250 – 300 µm. Min DFT 500 µm

\*Note-1: Certified to NSF / ANSI Standard.

\*Note-2: Paint shall be tested and certified according to AS/NZS4020:2005 or UL classification in accordance with ANSI/NSF Standard for potable water.


Note-3: Paint shall be for PSPC for water ballast tank according to IMO Res .MSC 215.

Note-4: Paint System 6C: Potable Water Tank made up of SS316, internal surface painting is not required.

Note-5: Paint System 6B: Pressure vessel internal painting shall be followed as per respective Spec of the item provided in the bid. In case, respective specification do not have specific requirement then Paint System 6B is to be followed.

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Note-6: Internal Surfaces of Tanks shall be coated as per intended use specified in this specification and respective Discipline Specification provided in the Bid.

13.6 **SECTION- E: Carbon steel Metal buildings**

13.6.1 **Skid**

Structural Steel: Method of surface preparation and acceptable coatings shall be followed as per Coating system No.2 Section – A (13.2).

Piping/Mechanical & Process: As per Section – B (13.3)

13.6.2 Structural Framing/Sheeting/Plating as per Coating System No.2

13.6.2.1 Exposed portions: Method of surface preparation and acceptable coatings shall be followed as per Coating system No.2 except Walkways, escape routes and lay down areas.

13.6.2.2 Unexposed portions covered by insulation, wall Panels, false roofing/ceiling and false flooring:

**Coating System No.7: Painting of Unexposed portions**


Application	Surface Preparation	Coating System	DFT in
Portions covered by insulation, wall Panels, false roofing and false flooring)	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 surface profile : 40-60 µm Max.	Primer Coat: Inorganic zinc silicate primer (F-3)	DFT Range 65 - 85 µm
		Sealer Coat/tie coat: One coat of low volume of epoxy Primer (F- 13) as recommended by manufacturer.	DFT Range 25- 30 µm
		Finish coat: One coat of high build epoxy with MIO pigments. (F- 1)	1 coat @ 125 – 150 µm.
		Total DFT (Minimum)	225 µm

13.7 **Section F - Antiskid Painting**

Coating system is applicable on **Steel plated Helideck**, Plated **Laydown Area**, Plated **Walkway**, and applicable area on **plated floor**.

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#### **Coating System No.8: Antiskid Painting.**

Application	Surface Preparation	Coating System	DFT in $\mu\text{m}$
Topcoat of <b>Steel plated Helideck, Laydown Area, Walkway (Plated) &amp; Plated flooring</b>	Cleanliness: SSPC –SP5/ Sa 3	<b>Extra high</b> build epoxy coating. Application as recommended by paint Manufacturer. (F-8) Top coat: one coat of Aliphatic acrylic polyurethane (F-9) (Refer General Note 1 to 5 below)	2500-3000 $\mu\text{m}$
	Roughness: 75 $\mu\text{m}$ to 100 $\mu\text{m}$		50-60 $\mu\text{m}$
		Total	2500-3000 $\mu\text{m}$

#### **General notes:**

1. Light colour non-skid aggregates shall be used.
2. Quantity and Particle size of non-skid aggregate shall be as per recommendation of paint manufacture.
3. Aggregates shall have a uniform spread.
4. Coating systems for escape route and lay down areas shall have adequate properties related to water absorption, impact resistance, coefficient of friction, hardness and flexibility.

#### **13.8 Section G : Epoxy Fire Protection (Epoxy Intumescent Coating)**

The recommended use for this product is for fireproofing of steel beams below cellar deck, Deck Legs, Jacket legs & braces, pipes, vessel skirts, bulkheads etc. for fire rating as per Fire Safety Study Report.

The epoxy intumescent coating shall provide pool and jet fire protection minimum one hour for well platform & two hours for Process platform.


Coating thickness shall be as per recommended by paint Manufacturer to obtain desired Fire rating based on safety study.

Base coat & Top coating on top of the passive fire protection shall be compatible with the passive fire protection coating. No hot work shall be done after fireproofing material is installed. Procedure for application shall be as per manufacturers' quality and application manual.

##### **13.8.1 \*Coating System No.9: Under epoxy based fire protection system.**

Applicati on	Surface Preparation	Coating System	DFT in $\mu\text{m}$
Carbon steel – Structural steel	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 surface profile : 40-60 $\mu\text{m}$ Max.	Primer Coat: Inorganic zinc silicate primer (F-3)	65 -85
		Sealer Coat/tie coat: Low volume epoxy primer as recommended by paint manufacturer (F-13)	25-30
		Top Coat: Thickness of Fire proofing coating shall be provided by Manufacturer for the desired Fire	

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		Rating (as per safety study). Coating material F-7.	
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\*Note: Epoxy Intumescent Coating shall be applied over a suitably primed substrate as per Recommendation of paint manufacturer. Procedure for application shall be as per Manufacture’s Quality & application manual.

Epoxy Intumescent Coating shall be top coated to meet colour schemes & finish and as per recommendation of paint manufacturer.

The fire ratings of Epoxy Intumescent Coating shall be obtained from Certification Agencies like UL, LRS, DNV, BV, etc. and submitted.

No hot work shall be carried out after completion of Fire proofing coating.

13.9 Section H: Epoxy Fire Protection (Epoxy Intumescent Coating)


The recommended use for this product is for fireproofing of steel beams below cellar deck, Deck Legs, Jacket legs & braces, pipes, vessel skirts, bulkheads etc. for fire rating as per Fire Safety Study Report. The epoxy intumescent coating shall provide pool and jet fire protection minimum one hour for well platform & two hours for Process platform. Coating thickness shall be as per recommended by paint Manufacturer to obtain desired Fire rating based on safety study. Base coat & Top coating on top of the passive fire protection shall be compatible with the passive fire protection coating. No hot work shall be done after fireproofing material is installed. Procedure for application shall be as per manufacturers’ quality and application manual.

13.9.1 \*Coating System No.9: Under epoxy based fire protection system

Application	Surface Preparation	Coating System	DFT in µm
Carbon steel –Structural steel	Cleanliness: Near white metal shot/grit blasting as Per SSPCSP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 surface profile: 40-60µm Max	Primer Coat: Inorganic zinc silicate primer (F-3)	65 -85
		65 -85 Sealer Coat/tie coat: Low volume epoxy primer as recommended by paint manufacturer	25-30
--	---	Top Coat: Thickness of Fire proofing coating shall be provided by Manufacturer for the desired Fire Rating (as per safety study). Coating material F-7.	---

Note: Epoxy Intumescent Coating shall be applied over a suitably primed substrate as per Recommendation of paint manufacturer. Procedure for application shall be as per Manufacture’s Quality & application manual. Epoxy Intumescent Coating shall be top coated to meet colour schemes & finish and as per recommendation of paint manufacturer. The fire ratings of Epoxy Intumescent Coating shall be obtained from

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Certification Agencies like UL, LRS, DNV, BV, etc. and submitted. No hot work shall be carried out after completion of Fire proofing coating.

**13.10 Section I: Miscellaneous items**

**13.10.1 Pipe Support: i-Rod Pipe Support System**

Corrosion Control in Piping Support & anchoring Steel U- Bend shall be carried out as per NACE SP 0108 (Standard Practice – Corrosion Control of Offshore Structure by Protective Coating).

Pipe Support shall also be so designed that there is no water accumulation beneath the pipe to avoid corrosion and deterioration of paint. Design of pipe support shall be such that there shall be enough space for recoating even at the bottom of pipe. One of method is to use semi sphere-shaped **Thermoplastic Pipe Support** Rod under the pipe to facilitate water drainage for future corrosion inspection and access to recoat. Alternative option is to overwrap the pipe wherever the pipe is being supported with a layer of fiber glass reinforced composite tape with adhesive backing. Alternatively contractor may also propose other alternative accordingly.

The U-bend shall be protected with a carbon black pigmented polychloroprene rubber sheath. The rubber sheath shall also provide abrasion resistance. Corrosion inhibitor grease should be applied onto the steel U-bend prior to inserting in the rubber sheath.

Contractor shall address all such aspect in Piping support standard and put up to Company for approval.

**13.10.2 Coating System No.10:** Painting of carbon steel valves.

Application	Surface Preparation	Coating System	DFT in µm
Painting of carbon steel valves with operating temperature up to 150°C.	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 Surface profile: 40-60 µm Max.	Two coats of Phenolic Epoxy (F- 6)	2 coat @ 150 – 175 µm. Min Thk 325 µm


**13.11 Section J: Extension & Modification on Old Platform and Repair & Maintenance painting of offshore platform**

i. Extension & Modification on Existing Platform Section A to I shall be followed with following change: Thermally Spread Aluminum Coating (TSAC) System is not applicable.

ii. Repair & Maintenance Painting.

**13.11.1 Evaluation of condition monitoring**

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The Principal will review the condition monitoring reports. Facility components found to be Inaccessible for coating condition inspection should be reported to the responsible Technical Authorities and Management. The barrier coating should be maintained within Two (2) years after the condition of the barrier is found to be not in accordance with the Minimum acceptance criteria. If repair work has not been carried out in time or if severe (Local) corrosion has been observed during condition monitoring, the responsible disciplines should be consulted on further actions to ensure safety and technical integrity.

The condition of all the components of an area/block, including insulation and passive Fireproofing, should be reviewed when drafting scopes of work for maintenance. Consideration should be given to whether it is justified to repair the coating barrier of a Single component only, or whether the whole area/block should be maintained. Specialist Knowledge, including insight into costs and techniques, may be required to make the choice between repair and large-scale maintenance. Specific consideration should be given to and thorough analysis made of areas and/or parts that cannot be inspected or maintained. Appropriate actions, such as risk analyses etc., to ensure long-term integrity should be instigated.

VISIBLE CORROSION DEGREES

The pictures given in ASTM D 610 can be used for the visual determination of the percentage of surface Rusting. These pictures are based on standards such as the European Scale of Degree of Rusting and ASTM D 610.

13.11.2 : Repair & Maintenance Painting system in **Atmospheric zone** shall be as under:

- Surface preparation: All surfaces should be clean and free from contamination. Solvent cleaning (SSPC-SP1) followed by hand or power tool cleaning (SSPC SP2 /SSPC SP3).  
The surface should be assessed and treated in accordance with ISO 8504.
- Cleanliness: Hand or power tool cleaning to minimum St.2, mill scale free (ISO 8501-1:1988).Improved surface cleaning with blast cleaning to Sa 2½.
- One coat of Self priming surface tolerant high build epoxy (F-2) coating @ 125 Microns DFT/Coat minimum (maximum DFT-150 microns)
- Top Coat – 1 coats (F-1) High build epoxy MIO coating cured with Polyamide/polyamine hardener @ 125 microns DFT/Coat minimum (maximum DFT – 150 microns/coat) = 1 X 125 =125 microns.
- Finish Coat (F- 9) - One Topcoat of Gloss Aliphatic Acrylic Polyurethane 70-80 micron dry film thickness.
- Total DFT: Minimum: 320 µm.

13.11.3 : Repair & Maintenance Painting in splash zone.

Application	Surface Preparation	Coating	Coating
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		System	DFT Range
Coating System No.3C: Splash zone: Jacket, Boat landing, Barge Bumper, conductors, Riser & Conductor Protector, clamps, etc.	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05- 5900/ISO 8501-1 Surface profile: 75-100 µm Max.	one coat of Ultra High Build Glass Flake Epoxy Coating (F- 11)	500-750 µm. Total 500 µm min.

**13.12 Miscellaneous Accessories**

Three identification boards, with name of the platforms shall be provided on North and South faces of the platforms and on the top of the helideck respectively. The details to be written on the boards shall be approved by the Company. The letters on the boards shall be at least 900 mm in size.

**13.13 Handling and shipping of coated items**

Coated items shall be carefully handled to avoid damage to coated surfaces. No handling shall be performed before the coating system is cured to an acceptable level. Packing, handling and storage facilities shall be of non-metallic type.

**14.0 APPLICATION OF THERMALLY SPRAYED ALUMINIUM COATING (TSAC)**


**14.1 TSAC REQUIREMENTS**

**14.1.1 Surface Preparation**

All the parts to be sprayed shall be degreased according to SSPC-SP 1. The absence of oil and grease after degreasing shall be tested by method given elsewhere in the specification. Thereafter the surface to be abrasive blasted to white metal finish as per NACE 1/SSPC-SP 5 for marine and immersion service. Using SSPC VIS 1, it is to be visually assessed that the blast cleaned surface meets requirement of SSPC-SP 5. Thereafter clear cellophane tape test as per ISO 8502-3 shall be used to confirm absence of dust on the blasted surface. Finally blasted surface shall be tested for presence of soluble salts as per method ISO8502-9. Maximum allowable salt content shall be considered 50mg/M<sup>2</sup>. (5 micrograms/cm<sup>2</sup>). In case salt content exceeds specified limit. The contaminated surface shall be cleaned by method as per Annex –C of IS 12944-4 (Water Cleaning.) After cleaning the surface shall be retested for salt content after drying.

The blasting media shall be either chilled iron or angular steel grit as per SSPC-AB-3 of mesh size G-16 to G-40. Copper or Nickel slag or Garret as abrasive will also be suitable having mesh size in the range of G16 to G24, conforming to SSPC-AB-1. Mesh size shall be required as appropriate to the anchor tooth depth profile requirement and blasting equipment

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used. The blasted surface should be having angular profile depth not less than 75 microns with sharp angular shape. The profile depth shall be measured according to NACE standard RP 0287 (Replica Tape) or ASTM D 4417 method B (Profile depth gauge).

For manual blasting one profile depth measurement shall be taken every 10-20 M<sup>2</sup> of blasted surface.

Surface preparation shall be completed in one abrasive blast cleaning operation wherever possible.

If rust bloom (visual appearance of rust) appears on the blast cleaned surface before thermal spraying, the affected area shall be re-blasted to achieve specified degree of cleanliness after which only thermal spraying shall commence. Air blasting pressure at nozzle shall be normally maintained at 100 psi. Air pressure and media size should be reduced and adjusted to preclude damage/distortion to thin gauge materials. Blasting time on work piece should be adjusted to only clean the surface and cut required anchor tooth with minimum loss of metal. Blast angle should be as close to perpendicular as possible but in no case greater than 30° from perpendicular to work surface. Blasting media must be free of debris, excessive fines, contaminants such as NaCl and sulphur salts (Ref. Clause 14.4.0 of this spec.).

#### 14.1.2 Blasting Equipment

The TSAC applicator shall use mechanical (centrifugal wheel) or pressure pot blast cleaning equipment and procedures. Suction blasting equipment shall not be used. Clause No. 14.4.6.2 shall be used to validate clean and dry air.

#### 14.1.3 Feed Stock

The feed stock shall be in the form of wire. The feed stock shall be 99.5% aluminium of commercial purity grade, its composition shall be in accordance with requirement of BS 1475 or ASTM B833 (wrought aluminium and aluminium alloys, wire).

#### 14.1.4 Thickness Requirement

The nominal thickness of finished TSAC shall be 225 microns having minimum value of 200 microns at low thickness areas (valleys) and not more than 250 microns at peak areas.

The finished thickness shall be measured using SSPC-PA 2 type 2 fixed probe gauge (Magnetic Gauge).

#### 14.1.5 Coating Bond Strength Requirement

During CPT coating bond strength requirement shall be as indicated in table 14.1.4.

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The Minimum Tensile Bond Requirements during production shall be 7 Mpa (1000 psi) for any single measurement.

The TSC tensile bond shall be measured according to ASTM D 4541 using a self-aligning adhesion tester.

For non-destructive measurement: Tensile force shall be measured to the 7Mpa (1000 psi). The tensile force shall then be reduced and the tensile fixture Removed Without damaging the TSAC.

#### 14.1.6 Porosity

All thermally sprayed metallic coatings will have porosity. For thermally sprayed aluminium coatings porosity shall not exceed 15% of total surface area for flame sprayed coating and 8% for arc spray coating.

### 14.2 THERMAL SPRAY APPLICATION PROCEDURE

Thermally spread Aluminium coating shall be applied by either Flame spray or Arc spray method and shall refer to Clause No. 13.2.1 for application area/zone.

#### 14.2.1 Equipment set up

14.2.1.1 Thermal spray equipment shall be set up calibrated, operated (1) according to manufacturer instructions/technical manuals and also TSAC applicators refinement thereto and (2) as validated by Procedure Qualification.

#### 14.2.1.2 Spray parameters

Spray parameters and thickness of each crossing pass shall be set and shall be validated with bend test.

#### 14.2.1.3 Table:

Spray Parameters	Method of Application	
	Arc wire Spray	Flame Wire Spray
Arc voltage	27 V	-
Air pressure	80 psi	80 psi
Steel surface cleanliness	NACE-1 white metal	NACE-1 white metal / or Near white metal
Steel surface profile	75 microns (minimum)	75 microns (min.)
Arc current	250-280A	-
Coating thickness	225 microns (nominal)	225 microns(Nominal)
Coating adhesion	> 1500 psi (Total coating),see 3.1.4	>1000 psi

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Coating porosity	Less than 8%	Less than 15%.
Spray distance (spray Gun work piece)	6-8"	5-7"
Spray Pass width	40mm	20 mm

The above parameters to be validated with a bend test by the contractor before start of work (for detail of Bend Test see clause No. 14.4.5 of this Spec.)

**14.2.2 Post Blasting Substrate condition and thermal spraying period.**

14.2.2.1 The steel surface temperature shall be at least 50C above dew point of ambient air temperature. Steel substrate surface temperature shall be recorded by with a contact pyrometer.

Thermal spraying should commence within 15 minutes from the time of completion of blasting

**14.2.2.2 Holding Period**

Time between the completion of final anchor tooth blasting and completion of thermal spraying of blasted surface should be no more than four hours.

**14.2.3 Pre-Heating**

For flame spraying, the initial starting area of 1-2 square feet to be preheated to approx. 120° C to prevent condensation of moisture in the flame on the substrate. For arc spraying the preheating is not required.

**14.2.4 Thermal spraying**

Spraying should commence only after validation of equipment set up by procedure qualification test and spray parameter validation tests described in Clause No. 14.5.0 and 14.4.5 respectively. **Thermal spraying must commence within 15 minutes from the time of completion of blast cleaning.**

The specified coating thickness shall be applied in several crossing passes. The coating bond strength is greater when the spray passes are kept thin. Laying down an excessively thick spray pass increases the internal stresses in TSAC and decreases the bond strength of total TSAC. The suitable thickness for crossing passes shall be determined by procedure qualification test.

For manual spraying, spraying to be done in perpendicular crossing passes to minimize thin spots in coating. Approx. 75-100 microns of TSAC shall be laid down in each pass.

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The surface geometry of the item or area to be sprayed should be inspected before application. The spraying pass and sequence shall be planned according to following.

- Maintain Gun as close to perpendicular as possible and within  $\pm 30^\circ$  from perpendicular to the substrate.
- Maintain nominal stand-off distance and spray pass width as given below:

Table 14.2.4.1:

Spray method	Standoff (Inches)	Spray pass width (Inches)
Arc Wire	6 – 8	1 ½ inch ( 40mm )
Flame wire	5 – 7	¾ inch ( 20mm )

**14.2.4.1 Rust Bloom (Visual appearance of rust or Discoloration)**

If Rust bloom appears on the blasted surface before thermal spraying, the affected area shall be re-blasted to achieve the specified level of cleanliness.

If Rust bloom in form of discoloration, or any blistering or a degraded coating appears at any time during application of TSAC, then spraying shall be stopped and acceptable sprayed area shall be marked off. The unsatisfactory areas shall be repaired to the required degree of surface cleanliness and profile.

Blast the edges of the TSAC to provide for 2-3" feathered area overlap of the new work into existing TSAC.

Then apply TSAC to the newly prepared surfaces and overlap the existing TSAC to the extent of feathered edge so that overlap is a consistent thickness.

**14.2.4.2 Masking**

Masking all those parts and surfaces which are not required to be thermally sprayed as instructed by purchaser should be inspected by applicator to ensure that they are properly marked and covered by purchaser.

Complex geometries (flanges, valve manifolds, intersections) shall be masked by applicator to minimize overspray i.e. TSAC applied outside spray parameters (primarily gun to substrate distance and spray angle).

**14.2.4.3 TSAC Finish**

The deposited TSAC shall be uniform without blisters, cracks, loose particles, or exposed steel as examined with 10 X magnification.

**14.3 SEALER**

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Sealant shall be applied after satisfactory application of TSAC and completion of all testing and measurements of the finished TSAC as per clause No.14.4.0 of this specification.

For shop work Sealer shall be applied immediately after thermal spraying and for field work sealer shall be applied within 8 hours. The sealcoat shall be thin enough to penetrate into the body of TSAC.

The materials for sealing the metal coating shall be:

- Two-component epoxy for operating temperatures below 120 °C (F-13).
- Aluminium silicone above 120 °C (F-14).

Volume solids in the sealers when applied shall be 15 % nominal. The overlay of sealer should be less than 38 µm (1.5 mil) on the TSA coating after application.

The sealer should have a contrasting colour to the TSA to aid visual inspection.

During application of seal coat, complete coverage shall be ensured by visual observation.

#### 14.4 TESTING AND MEASUREMENT SCHEDULE

##### 14.4.1 Surface Finish

That the blasted cleaned surface meets the required criteria (NACE 1/SSPC-SP 5) shall be visually inspected using SSPC-VIS 1. The clear cellophane-tape test shall be used to confirm absence of dust or foreign debris on the cleaned surface.

##### 14.4.2 Blast Profile Measurement: (In-Process testing during actual production before application of TSA coating)


The angular profile depth measurement shall be done by profile tape as per method NACE Standard RP 0287 or ASTM D 4417 method B (Profile depth gauge micrometre). Spot measurement shall be carried out every 15m<sup>2</sup> of blasted surface. At each spot three measurements shall be taken over an area of 10 cm<sup>2</sup> and average of measurements to be recorded and reported.

If profile is <75 microns blasting shall continue till greater than 75 microns depth profile is achieved.

##### 14.4.3 TSAC Thickness (In-Process Testing For finished coating during regular production)

###### 14.4.3.1 TSAC finished thickness shall be measured using SSPC-PA 2 type 2 fixed probe gauge.

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14.4.3.2 For flat surfaces, measurements shall be taken along a straight measurement line; one measurement line for every 15 m<sup>2</sup> of applied TSAC shall be selected along which 5 measurements to be taken at 25 mm interval and average to be reported.

14.4.3.3 For curved surface or complex geometry, 5 measurements shall be taken at a spot measuring 10 cm<sup>2</sup> in area. One spot to be taken for every 15 m<sup>2</sup> of applied TSAC area.

14.4.3.4 The TSAC thickness in surface changes or contour changes, welds and attachments shall be also measured and reported.

14.4.3.5 If TSAC is less than specified minimum thickness, apply additional TSAC until specified thickness range is achieved.

14.4.3.6 All locations and values of TSAC thickness measurements shall be recorded in Job Record (JR).

14.4.4 Tensile Bond Testing (In-Process testing for finished coating during regular production)

- Tensile Bond strength of the TSAC finish coat shall be determined according to ASTM D 4541 using a self-aligning adhesion tester.
- One measurement shall be made every 50 m<sup>2</sup>. If tensile bond at any individual spot is less than 1000 psi for flame sprayed coating and 1500 psi for arc sprayed coating the degraded TSAC shall completely remove and reapplied.
- The tensile bond portable test instrument to be calibrated according to ASTM C 633.

14.4.5 Bend Tests


Bend test shall be carried out at beginning of each work shift. Bend tests shall also be conducted on sample coupons before start of thermal spraying work to qualify the following as mentioned earlier in this specification.

- To qualify spray parameters and thickness of each crossing pass.

14.4.5.1 Test Procedure

- a) Five corrosion control steel coupons each of dimension 50 mm x 150 mm x 1.3 mm thick are to be prepared.
- b) Surface shall be prepared by dry abrasive blast cleaning as per this specification.

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c) TSAC shall be applied as per specified thickness range. TSAC should be sprayed in crossing passes laying down approx. 75-100 microns in each pass.

d) TSAC applied coupons shall be bent 180° around a 13 mm diameter mandrel.

e) Bend test shall be considered passed if on bend radius there is - No cracking or spalling or lifting by a knife blade from the substrate

- No cracking or spalling or lifting by a knife blade from the substrate.
- Only minor cracking that cannot be lifted from substrate with a knife blade.

f) Bend test fails if coating cracks with lifting from substrate.

14.4.6 Tests for blasting media, blasting air

14.4.6.1 Blasting Media (For every fresh batch of media and one random test during blasting)

a) Blasting Media shall be visually inspected for absence of contamination and debris using 10 X magnification.

b) Inspection for the absence of oil contamination shall be conducted using following procedure:

- Fill a small clean 200 ml bottle half full of abrasive.
- Fill the bottle with potable water, cap and shake the bottle.
- Inspect water for oil film/slick. If present, the blasting media is not to be used.

c) Soluble salt contamination if suspected shall be verified by method ASTM D 4940 if present media is to be replaced.


d) Clean blasting equipment, especially pot and hoses and then replace blasting media and retest.

14.4.6.2 Test for Blasting Air (Once Daily before start of blasting and once at random during blasting)

The air for blasting shall be free from moisture and oil. The compressor air shall be checked for oil and water contamination per ASTM D 4285.

14.4.7 Test for presence of oil/grease and contamination

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The steel substrate after degreasing as per SSPC-SP 1 shall be tested as per following procedure to validate absence of oil and grease contamination.

a) Visual inspection - Continue degreasing until all visible signs of contamination are removed.

b) Conduct a solvent evaporation test by applying several drops or a small splash of residue- free trichloromethane on the suspect area especially pitting, crevice corrosion areas or depressed areas. An evaporation ring formation is indicative of oil and grease contamination.

Continue degreasing and inspection till test is passed.

#### 14.5 TSAC APPLICATOR QUALIFICATION

Following tests to be carried out as part of procedure qualification test for the applicator.

- Thickness measurement
- Coating bond strength
- Porosity test
- Bend strength

TSAC applicator's surface finishing and application process and equipment set up, calibration and operation shall be qualified by application of TSA on a reference sample which shall be used as a comparator to evaluate the suitability of application process. Only that applicator will be permitted to carry out the work when test specimens coated by the applicator meets the desired requirements as cited below.

The sample shall be made of a steel plate measuring approx. 18"x 18" x ¼" thick. If the actual work is less than ¼" thick then the sample to be made from material of representative thickness.

The surface preparation, TSAC application shall be made with actual field equipments and process/spray parameters and procedures as per the specification. The depth profile of blasted surface, TSAC coating thickness for each cross pass and total thickness range shall be as per specification.

The surface preparation and thermal spraying shall be carried out in representative environmental conditions spraying with makeshift enclosure.

##### 14.5.1 After application of coating, thickness and tensile bond measurements shall be made in following manner.

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- Divide the sample piece into four quadrants.
- Measure thickness along the diagonal line of each quadrant.
- Four each quadrant five in-line thickness measurements at 1" interval shall be done using SSPC-PA 2 type 2 fixed probe gauge. Thus a total of four "five in line" thickness measurements are to be done for the whole sample.
- One tensile bond measurement using ASTM D 4541 type III or IV portable self-aligning test instrument to be done at centre of each quadrant. Total of 4 measurements for the sample.
- One porosity evaluation test by Metallographic examination shall be conducted to demonstrate the achievement of porosity within the limits specified. Sample shall be prepared for Metallographic examination as per ASTM E – 3.
- The procedure shall be considered qualified if thickness and tensile bond strength and porosity values meets the specification requirement.

14.5.2 Bend test: Bend test shall be carried out as detailed at Clause No. 14.4.5 of this specification.

- Applicators thermal spray equipment set-up, operation and procedure of application including in-process QC checkpoints adopted during procedure qualification as described above should be always subsequently followed during entire duration of work.

#### 14.6 Documentation

The following information shall be provided by TSAC applicator before award of work.

- TSAC application process consisting of equipment capabilities and their technical parameters, feed stock material and source of procurement.
- Detailed application procedure and in-process quality control check points for (a) surface preparation (b) thermal spraying (c) seal coats.
- Type and specification of instruments to be deployed for measurement of blast profile depth, TSAC thickness and tensile bond.
- Paint manufacturer data sheet for the selected sealing coat to be applied.

#### 14.7 RECORDS

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- The TSAC applicator shall maintain job record to record production and QC information. All the results of the tests and quality control checks shall be entered in the record for each component/part thermally sprayed. All the result of tests (thickness, tensile bond, bend tests) and other validation tests (e.g. procedure qualification test, test for surface cleanliness after abrasive blasting, test for cleanliness of abrasives and air) shall also be recorded and duly signed by owner.
- All the information mentioned in Clause no. 14.6.0 above should also form part of the Job record.
- Any modification affected after procedure qualification in the procedure, QC, spray parameter, equipment spec to the original information (submitted before award of the work) must also form part of Job record.

#### 14.8 WARRANTY

The TSAC applicator shall warrant the quality of material used by providing the purchaser with a certificate of materials used to include

- Spray feed stock: Alloy type/designation, Lot Number, wire diameter, chemical analysis, name of supplier, manufacturer.
- Sealant: Name of manufacturer, application data sheet.

#### 14.9 SAFETY

The TSAC applicator shall follow all safety procedures required by the purchaser/owner. Owner shall also give compliance requirement to be followed by applicator. The applicator shall follow all appropriate regulatory requirements.

#### 14.10 CODES AND STANDARDS

This specification shall apply in case of conflict between specification and following applicable Codes & Standard:

AWS C.2.17	Recommended Practice for Electric arc Spray.
ASTM C 633	Test Method for Adhesive/Cohesive Strength of Flame Sprayed Coatings.
ASTM D 4285	Method for indicating Oil or Water in Compressed Air.
ASTM D 4417	Test Method for Field Measurement of Surface Profile of Blasted Steel.
BS 2569	Specification for Sprayed Metal Coating.
NACE Standard RP 0287	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape.

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ASTM D 4541	Test method for Pull-Off Strength of Coating Using Portable Adhesion Testers.
ANSI/AWS C2.18	Guide for the Protection of Steel with Thermal Spray Coatings of Aluminium, Zinc and Their Alloys and Composites.
NACE No. 12/AWS C2.23M/SSPC-CS	Specification for the application of thermal spray coatings (Metallizing) of aluminium, zinc, and their alloys and composites for the corrosion protection of steel.
SSPC Publication	The inspection of coatings and linings: A Handbook of Basic practice for Inspectors, Owners, and Specifiers.
SSPC-AB 1	Mineral and Slag Abrasives.
SSPC-AB 3	Ferrous Metallic Abrasives.
SSPC-PA 1	Shop, Field, and Maintenance Painting of Steel.
SSPC-PA 2	Measurement of Dry Coating Thickness with Magnetic Gages.
NACE No. 1/SSPC-SP 5	White Metal Blast Cleaning.
NACE No. 2/SSPC-SP 10	Near –White Metal Blast Cleaning.
SSPC-VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning.

**14.11 Suggested List of TSA applicators**

- 1) *Metallizing Equipment Corporation, Jodhpur, India*
- 2) *Larsen & Tuobro Ltd (Eutectic division), New Delhi, India*
- 3) *Chemtreat India Ltd, Navi Mumbai, India*
- 4) *Deepwater MPE, Malaysia*
- 5) *Associated Thermal Spray, Ahmedabad, India*
- 6) *M/S PS Coatings Pvt. Ltd, New Mumbai, India*
- 7) *M/S NPCC, Abu Dhavi*
- 8) *M/S McDermott, Jebal Ali, Dubai*
- 9) *M/S PTSC, Vietnam*

TSAC coating shall be applied to bottom of bridge including bottom of deck plating of bridge & piping.

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Other applicators will also be acceptable if they qualify the applicator qualification procedure given in the specification. If any one of the above suggested applicator is selected, even then he has to perform the qualification test before commencing of the work.

## 15.0 COLOUR SCHEDULE

### 15.1 Table No.

Sr. No.	Item to be Painted	Finish Coat Colour	Colour Code No.
<b>A</b>	<b>SPLASH ZONE</b>		
1	All areas coated with XHB Glass flake reinforced Epoxy	Golden Yellow	RAL 1004
2	Handrails & Ladders		
<b>B</b>	<b>ATMOSPHERIC ZONE-I &amp; II</b>	Golden Yellow	RAL 1004
1	All areas coated with System 2 (Structural steelwork)	Golden Yellow	RAL 1004
2	Handrails and ladders	Golden Yellow	RAL 1004
3	Buildings (outside surfaces)	Spanish Tile Red	RAL 3000
4	Overhead Obstructions	Golden Yellow with Black Strip	RAL 1004 & RAL 9012
5	Helideck top surface (marking colour shall be as per CAP437 , (7 <sup>th</sup> Edition ) guideline)	Dark Green	RAL 6020
6	Walkway of Helideck	Dark Green with White side strips	RAL 6020+ RAL NO.9010
<b>C</b>	<b>EQUIPMENT, PIPING AND TUBING</b>	Natural Grey	RAL 7038
1	Pumps and Drivers	Dark Grey or Factory Finish	RAL 7039
2	Compressors and Drivers	Dark Grey or Factory Finish	RAL 7039
3	Generators and Drivers	Dark Grey or Factory Finish	RAL 7039
4	Water Makers	Light Blue or Factory Finish	RAL 5012
5	Tanks and Vessels	White	RAL 9003
6	Electrical Equipment incl. Cable Trays	Aluminium Grey	RAL 9007
7	Electrical Danger Points	Orange	RAL 2004
8	Instrumentation	Factory Finish	-----
9	Fire Fighting Equipment	Red	RAL 3000
10	First Aid Equipment	Signal Green	RAL 6032
11	Risers and J Tubes	Aluminium Grey	RAL 9007
12	Process Piping Systems	Refer Table 15.2 of this specification	

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The name tag no. and service of all equipment should be stencilled in capital letters 40 – 50 mm in height on the equipment. The Colour shall be black or white and in contrast to the colour on which the lettering is superimposed.

## 15.2 Pipe Colour Coding

All piping shall be colour coded to identify service in accordance with the following criteria. The colour coding shall comply with the schedule in Table 15.

**TABLE No. 15.2: PIPE COLOUR CODING (PROCESS) COLOUR SCHEME FOR PRODUCT BEING PROCESSED**

Sr. No.	Description	Colour code Identification	
		Base/Ground Colour (Colour code no.)	Colour Bands 1)1 <sup>st</sup> Band 2)2 <sup>nd</sup> Band
GASES			
1	Sour Gas	Canary Yellow (RAL NO.1012)	1)Grey(RAL NO.7000) 2)Dark Violet (RAL NO.5022)
2	Sweet Gas	Canary Yellow (RAL NO.1012)	Grey (RAL NO.7000)
3	Fuel Gas	Canary Yellow (RAL NO.1012)	1)Light Brown(RAL NO.8025) 2)White(RAL NO.9010)
4	Residue	Canary Yellow (RAL NO.1012)	1)Oxide Red(RAL NO.3009) 2)White(RAL NO.9010)
5	Flare Gas	Canary Yellow (RAL NO.1012)	Aluminum(RAL NO.9006)
6	Regenerated Gas	Canary Yellow (RAL NO.1012)	1)White(RAL NO.9010) 2)Dark Violet(RAL NO.5022)
LIQUIDS			
1	Crude Oil	Light Brown (RAL NO.8025)	No Band
2	High Speed Diesel	Light Brown (RAL NO.8025)	1)Brilliant Green(RAL NO.6038, 6017) 2)White(RAL NO.9010)
3	Hydrocarbon Condensate	Dark Admiralty Grey(RAL NO.7031)	1)Signal Red (RAL NO.3020) 2)Black(RAL NO.9005)
4	Chlorine	Dark Violet(RAL NO.5022)	Signal Red(RAL NO.3020)
5	Triethylene Glycol (TEG)	Dark Admiralty Grey (RAL NO.7031)	1)Sea Green (RAL NO.6018) 2)Yellow (RAL NO.1003)
6	Oily Water	Black (RAL NO.9005)	No Band
7	Dosing Chemical	Dark Admiralty Grey (RAL NO.7031)	No Band

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8	ATF	Dark Admiralty Grey(RAL NO.7031)	Black(RAL NO.9005)
<b>UTILITY ITEMS: WATER</b>			
1	Drinking Water	Sea Green (RAL NO.6018)	1)French Blue (RAL NO.5002) 2)Signal Red(RAL NO.3020)
2	Domestic Hot Water	Sea Green (RAL NO.6018)	Light Green(RAL NO.6021)
3	Cold Water from Storage Tank	Sea Green (RAL NO.6018)	1)French Blue (RAL NO.5002) 2)Canary Yellow(RAL NO.1012)
4	Demineralized Water	Sea Green (RAL NO.6018)	Gulf Red(RAL NO.8019)
5	Cooling Water	Sea Green (RAL NO.6018)	French Blue (RAL NO.5002)
6	Condensate Water	Sea Green (RAL NO.6018)	1)Light Brown (RAL NO.3009) 2)Signal Red(RAL NO.3020)
7	Wash Water	Sea Green(RAL NO.6018)	Canary Yellow(RAL NO.1012)
8	Fire water	Fire Red(RAL NO.3000)	Crimson Red(RAL NO.3007)
9	Sea Untreated water	Sea Green(RAL NO.6018)	White(RAL NO.9010)
10	Waste Water	Sea Green (RAL NO.6018)	1)Canary Yellow(RAL NO.1012) 2)Signal Red(RAL NO.3020)
11	Treated Water	Sea Green (RAL NO.6018)	Light Orange(RAL NO.2003)
<b>UTILITY ITEMS: COMPRESSOR</b>			
1	Compressed Air (upto 15kg/sq.cm)	Sky Blue (RAL NO.5015)	-----
2	Compressed Air (above 15kg/sq.cm)	Sky Blue(RAL NO.5015)	Signal Red(RAL NO.3020)
3	Plant Air	Sky Blue(RAL NO.5015)	Silver Grey(RAL NO.7001)
4	Instrument Air	Sky Blue(RAL NO.5015)	French Blue(RAL NO.5002)
5	Drainage	Black(RAL NO.9005)	-----
<b>UTILITY ITEMS: OILS</b>			
1	Lubricating Oil	Light Brown(RAL NO.8025)	Light Grey(RAL NO.7004)
2	Hydraulic Power	Light Brown(RAL NO.8025)	Dark Violet(RAL NO.5022)
<b>UTILITY ITEMS: GASES</b>			

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1	Acetylene	Canary Yellow (RAL NO.1012)	Service Brown(RAL NO.8022)
2	Nitrogen	Canary Yellow(RAL NO.1012)	Black(RAL NO.9005)
3	Oxygen	Canary Yellow(RAL NO.1012)	White(RAL NO.9010)
4	Carbon di Oxide	Canary Yellow(RAL NO.1012)	Light Grey(RAL NO.7004)

Note: Any product which is not covered will be governed as per colour code standard IS: 2379/other standard under reference.

### 15.3 Colour Bands for Identification & Size of pipe

#### 15.3.1 Identification & Size

The Width of colour band shall confirm to the following (As per IS 2379)

Sr. No.	Nominal Pipe Size	Width : L (mm)
1	80NB and below	25
2	Over 100 NB upto 150 NB	50
3	Over 200 NB upto 300 NB	75
4	Over 350 NB	100
The relative proportional width of first colour band to be subsequent bands shall be 4:1. Maximum stripe spacing shall be 150mm		

#### 15.3.2 Application

Color Bands shall be applied at the following location as per # 7.3 of IS: 2379

- Battery Limit points
- Intersection point and change of direction points in piping ways
- Other point such as midway of each piping way, near valves, junction joints of service appliances, walls on either side of pipe culverts
- For long stretch yard piping at 50 m interval and at start and terminating points

Color bands shall be arranged in the sequence shown in table below and sequence follows the direction of flow.

For Insulation pipes, nominal pipe size means the outside diameter of insulation.

### 15.4 Colour of Valves

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The Valves shall be painted as per As per IS: 2379

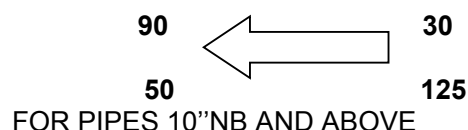
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Sr. No.	Condition	Colour of Valves
1	Valves on Fire fighting	Red (RAL NO.3000)
2	Valves on Pipe carrying Hazardous Material	Golden Yellow with black strips (RAL NO.1004) & (RAL NO.9005)
3	Valves on Water carrying piping (Potable or Non-Potable)	French Blue(RAL NO.5002)
4	All Other Piping	Same colour as the main piping

### 15.5 SIZE OF FLOW DIRECTION ARROWS

Pipes shall be marked with arrow to indicate flow direction as per the isometrics. Arrow markers shall be placed at starting / termination point of piping above each floor generation at a height of about 1.5m from floors. The service or the origin place shall also be marked in the same colour, stenciled in capital letters 40 - 50 mm in height. The colour or arrow shall be black or white and in contrast to the colour on which they are superimposed. The arrow indicating flow directions as per piping isometrics shall be marked on both sides of the pipe 180 deg. Apart at an interval of 3 to 6 meters or less depending on pipe length.

Size (in mm) of the arrow shall be either of the following:



### 15.6 Colour Schedule for Fire Fighting Equipments:

Fire Equipments/Fire Fighting Equipments colour shall be in accordance with following criteria as detailed in table 14.6

Table No. 15.6

Sr. No.	Item/Application	Standard Color	Painting	RAL No.
1	A. Extinguishers: Water based, foam, DCP, CO2			
	B. all fire tenders /jeep, fire engines(except foam tank, foam piping & nitrogen cylinder)			
	C. Fire tender, water piping/wet risers.			

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	Fire hose reel box D. Fire tender water pump & engine/water pipeline in engine & pump E. DCP tank & DCP piping	Fire red Paint	(RAL NO.3000)
2	Foam tank & foam piping/nitrogen cylinder	Dark Admiralty Grey	(RAL NO.7031)
3	Driver compartment & inside of the lockers	Pale Cream	(RAL NO.9001)
4	Chassis & wheel arches	Black	(RAL NO.9005)
5	Fire services insignia & identity nomenclatures	Canary yellow with black border on sides of sides of the vehicle/equipment	(RAL NO. 1012) & (RAL NO. 9005)

#### 16.0 RECOMMENDED LIST OF PAINT MANUFACTURERS

Refer updated Vendor List in ONGC Website.

#### 17.0 PROCEDURE FOR APPROVAL OF NEW COATING MATERIAL


Following procedure recommended is to be followed for approval materials Manufactured by new manufactures (indigenous and foreign):

1. The manufacturer should arrange testing of the coating materials as per the List of tests given in para 5 below from one of the reputed Government Laboratories.
2. Samples of coating materials should be submitted to the Govt. Laboratory in sealed containers with batch number and test certificate on regular format of manufacturer's testing laboratory.
3. All test panels should be prepared by the Govt. testing agency-colored photographs of test panels should be taken before and after the test and should be enclosed along with test report.
4. Sample batch number and manufacturers test certificate should be enclosed along with the report. Test report must contain detail of observations and rating if any as per the testing code. Suggested Govt. laboratories are:

RRL, Hyderabad

HBTI, Kanpur

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<p>DMSRDE, Kanur</p> <p>IIT, Bombay</p> <p>BIS, Laboratories</p> <p>UDCT, Mumbai</p> <p>Or Other International Test houses of Repute to be approved by the Company.</p> <p>a. Manufacturers should intimate the company, details of sample submitted for testing, name of Govt. testing agency, date. 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 the Company's decision in this regard - shall be Final and binding on the manufacturer.</p> <p>1. All tests required for evaluation of acceptance coating materials for offshore application shall be as per the relevant ASTM standards.</p>												
<p><b>18.0 PAINT PERFORMANCE GUARANTEE OF PROTECTIVE COATING:</b></p> <p>Contractor shall provide performance Guarantee for protective coating for the period as specified in Volume – I of Bid Document.</p>												
<p>-----END-----</p>												

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