TECHNICAL SPECIFICATION

OF

PAINT COATING

EDITION : **MARCH 2015**

DOCUMENT NO : **AE-S-5430 - Rev-1**

(Note: With these specifications, earlier Documents No.AE-DEP-C-03 Edition: January 2006 shall be kept in abeyance & not to be referred in future.)

					SIGNATURE
1	S. D. AGAWANE	R. B. TUPE	P.J.M. RAO	31.03.15	For addition of new painting systems and clarity in painting of tanks.
0	S. PERUMALAMY	R. B. TUPE	P.J.M. RAO	02.04.12	NIL
REV NO.	**PREPARED BY**	**REVIEWED BY**	**APPROVED BY**	**DATE**	**REMARKS**

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1.0 SCOPE AND GENERAL INTRODUCTION

This specification is applicable to general requirements of painting / coating within BPCL, Mumbai Refinery. These requirements must be fulfilled and complied for painting and coating of all equipment, pipelines, and storage tanks when they are off stream /shutdown and new fabrication. However on specific situational based recommendation from area inspection engineer, painting may be carried out with certain cautious deviations from these requirements such as painting without stipulated surface preparation. Painting includes surface preparation, clean up and application of painting. As a part of the periodical review of the specification, it has been reviewed the existing practices vis-a vis current industrial practices and available products with reputed painting manufacturers for enhancing effectiveness and durability of the painting systems.

Accordingly, revised painting specification has been prepared for implementation at BPCL – Mumbai Refinery. Scope of work covered in this specification shall include, but not limited to the following:

- Surface preparation
- Selection and application of painting on:
    a) Equipment including high temperature surfaces.
    b) Piping
    c) Steel Structures, buildings.
    d) Storage Tanks
    e) High temperature surfaces (Furnace casings, Stacks etc.).

1.1 Codes and standards

Following relevant international standards were considered.

SURFACE PREPARATION STANDARDS

a. Swedish Standards
b. Steel Structures Painting Council (SSPC)
c. NACE Standards
d. ISO 4624, ISO 2802

The contractor shall arrange, at his own cost, to keep a set of latest edition of all the reference standards and codes at work site.

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

a) Instructions for storage (Shelf life)
b) Surface preparation prior to painting
c) Mixing and thinning
d) Application of paints and recommended limit on time intervals between coats

2. 0 SURFACE PREPARATION METHODS

Most metallic articles that are usually given protective coatings are heavily contaminated and require, at least, some cleaning treatment before the coating is applied. The importance of surface preparation cannot be over emphasized as many investigations have shown convincingly that the performance and durability of any protective coatings are, to a large extent governed by the thoroughness of surface preparation. Often they concluded that careful cleaning and preparation of the surface were more important than the quality of the protective coating.

Surface contamination in the form of rust, scale, oil grease and dirt must be removed before painting. Invisible contamination may also be present and represents, on the whole, a greater hazard. Examples of the latter are soldering fluxes, perspiration in the form of hand marks, chlorides from marine atmosphere and sulfite from industrial atmosphere.

The following table-1 gives surface preparation specification in the descending order.

TABLE – 1: Surface Preparation in Descending Order of Effectiveness

Sl. No.	**Methods of cleaning**	**Specifications NACE/SSPC/SIS-05-5900**
1.	White metal blast	NACE # 1, SSPC SP 5-63,SA-3
2.	Near –white metal blast	NACE # 2, SSPC SP 10-63,SA-2.5
4.	Acid Pickling	SSPC SP 8-63,
5.	Brush Blast	NACE # 4, SSPC SP 7-63,SA-1
6.	Flame Clean and Power Sanding	SSPC SP 4-63
7.	Power Tool Cleaning	SSPC SP 3-63
8.	Chip and Hand Wire Brush	SSPC SP 2-63
9.	Solvent Wipe	SSPC SP 1-63

Note: (Sand blasting is not allowed in Refinery and MOT; hence Cu slag shall be used in all such cases except crude oil tanks internals) ⚠
CU slag grading:

a. **0.2 to 2.4 mm - coarse sieve for paint & rust removal.**
b. **0.4 to 1.5 mm – for general new surfaces.**

Cu slag is specified as a standard blasting material for BPCL-MR, as this will not create spark on metal surface while blasting. Cu slag is not reusable, resulting in less / negligible surface contamination.

2.1 Inspection of blasted steel surface

For the purpose of inspecting the blasted steel surface with cu slag abrasive, the respective **"Visual standards"** can be utilized.

White metal blast (SSPC 5-63, NACE No.1, and SA-3)

This is defined as removing all rust, scale, paint etc. to a clean white metal which has a uniform Grey white appearance. Streaks and stains of rust or other contaminants are not allowed.

Near white metal (SSPC 10-63, NACE No.2, SA – 2.5)

This provides a surface of about 95% as clean as white metal. Light shades and streaks are not allowed.

Commercial blast (SSPC 6-63, NACE No.3, SA –2)

This type of blast is more difficult to describe. It essentially amounts to about 2/3 of a white metal blast, which allows for very slight residues of rust and paint in the form of staining.

Brush of blast (SSPC 7-63, NACE No.4 SA-1)

This preparation calls for removal of loose rust, paint, scales, etc. Tightly adherent paint, rust and scale is permitted to remain.

2.2 <u>Pictorial Standards of different surface preparation to be adopted</u>

During surface preparation operations, the surface condition obtained has to be compared with pictorial standards available for getting the specified condition.

3. 0 PAINT APPLICATION

The purpose of painting/coating application is to develop a continuous highly adherent film with an even thickness over the substrate. To achieve this, various factors have to be considered such as type of coatings and weather conditions, application methods etc

APPLICATION RESTRICTIONS

For all cases, paint manufacturer guidelines shall be followed. Following restrictions are given as recommended practices:

1. Coating application shall not be permitted during fog, mist or rain.

2. Coating application shall not be permitted when the relative humidity is 85 percent or above.

3. Coating application shall not be permitted when the steel surface temperature and/or ambient temperature is below 10°C (50°F) .

4. Coating application shall not be permitted when the steel surface temperature and/or ambient temperature is above 50°C (120°F).

5. Coating application shall not be permitted when the steel surface temperature is less than 3°C (5°F) above the dew point.

6. Humidity and dew point readings shall be taken by contractor with a sling Psychrometric meter and calculated using psychrometric tables. Readings shall be taken prior to coating operations commencing and at least every four hours while coating application is ongoing.

7. Coatings shall not be applied before the surface has been inspected and the preparatory work approved.

8. All sharp projections shall be ground to min. 2 mm radius and a thick stripe coat shall be applied at sharp edges.

9. Fresh water blasting or fresh water mopping shall be carried out on Salt water spray areas before application of primer to remove the salts deposited on metal surface. Mopping can be repeated before application of other coats to remove salts deposited on previous coats, if such deposits are suspected. The permissible Chloride content for water used shall be 50 ppm maximum.

4.0 INSPECTION AND TESTING OF PAINTING MATERIAL

1) Painting Contractor shall procure from approved manufacturers as given below:

- Akzo Nobel paints
- Asian Paints PPG Ltd
- Berger paints Ltd
- CDC Carboline Ltd
- Goodlass Nerolac Paints Ltd
- Growel India (old - Bombay Paints)
- Hempel paints 
- Jotun coatings
- Kirloskar corrocoats 
- PPG Ind USA (Sigma Coatings & Amercoat)
- Shalimar paints Ltd.

Additional manufacturers may be approved by BPCL Inspection, subjecting to technical evaluation. All the procured paint material along with batch/test certificates shall be offered for BPCL inspection for approval. Remaining Shelf life shall be at least 90% of the total duration at the inspection above.

2) All paint materials shall be accompanied by Manufacturer Test Certificate. All zinc based paints shall have minimum 85% of metallic Zinc by weight of total solids on dry film. Glass flake epoxies shall have minimum 20% of glass flake pigments in dry film by weight of total pigments.

3) Inspection Engineer at his discretion may test paint formulations, if required.

4) Minimum suggested stages of inspection shall be:

   a. Surface Preparation
   b. Primer application
   c. Each coat of paint

5) All defects noticed during stages of inspection, shall be rectified free of cost by the contractor. All records shall be kept by the contractor.

6) To avoid rework it is preferable to take wet film thickness measurements during painting in order to ascertain the adequacy and uniformity of thickness.

7) Dry film thickness shall be taken on each coat after drying and curing of the coat. Dry film thickness (DFT) readings shall be taken using a non-destructive dry film thickness instrument capable of storing the readings. Sufficient readings shall be taken covering each coat prior to application of the following coat to ensure the correct required DFT. The DFT indicated against each system shall be obtained by applying one or more coat of the paint based on paint properties. The Contractor is responsible to obtain the indicated DFT as per painting system specification.

8) DFT meter used shall be calibrated before each inspection and shall be witnessed by the Inspector. It is the duty of the Inspector to satisfy him/herself with the performance of the DFT meter.

9) Frequency of inspection and criteria for acceptance of painting work shall be in accordance with the following table - 2:

TABLE – 2:

Test	Standard	Frequency	Acceptance criteria
Surface cleanliness	ISO 8501-1	One per ten (10) square meters	Sa 2 ½
Surface Profile	ISO 8503-2	One per ten (10) square meters	As per coating procedure / data sheet
Total Soluble salt ⚠ contamination	ISO 8502-9	One per twenty (20) square meters or minimum 5 tests whichever is more.	$<5\mu g/cm^2$

Dust	ISO 8502-3	One per ten (10) square meters	Rating 2 or better
Adhesion	ISO 4624	One pretest panel, per shift	5 MPa
Holiday Detection	NACE RP0188	100% of surface	Zero defects
Dry Film Thickness ⚠11	SSPC PA-2	As per Annexure – F	Shall not be less than 80 % and more than 120 % of Specified dry film thickness (DFT).
Wet Film Thickness	ISO 2802	One per ten (10) square meters	Consistent with providing required DFT

10) Each contractor shall deploy adequate number of NACE CIP Level 1 qualified coating inspectors to monitor and inspect the surface preparation, storage, handling, mixing and application on substrate of the painting/coating and to ensure the compliance of this specification. The Inspection test plan which will be mandatory part of the contract shall be prepared by the above qualified inspector and get approved by BPCL. The CONTRACTOR's qualified coating inspector and BPCL shall sign an inspection report as per approved inspection test plan. The report shall consist, as a minimum, of the following in addition to the inspection parameters and acceptable criteria as above table - 2.

- Names of the APPLICATOR and the responsible personnel.
- Dates when work was carried out.
- Equipment and techniques used.
- Type and calibration of instruments used.
- Weather and ambient conditions.

11) Each contractor shall possess relevant standards and deploy all inspection tool/instrument to carry out the all above inspection and testing as per relevant standard.

12) For coating different color shades to be used for primer and intermediate coats, for ease in monitoring & identification of number of coats. ⚠11

5.0 FREQUENCY & GUARANTEE

Painting system frequency & guarantee except crude oil tank shall be AS follows:

a. For surfaces painted after Blasting as surface preparation 5 years

b. For surfaces painted after Manual Cleaning as surface preparation 4 years

c. For area within 100 m radius of Sea water cooling tower area (salt water spray area), 3 years.
d. Guarantee period shall be same as frequency.
e. Paint material shall be procured from approved manufacturers who also will stand guarantee as above clause.
f. For all internal lining / painting works, manufacturer's laboratory test statement / Laboratory Paint performance certificates to be checked for specified services at design / operating conditions. Material shall be procured from only those approved manufacturers who will meet the above stated criteria.
g. For crude oil tanks frequency and guarantee shall be as per point no. 13 ⚠

6.0 PAINT MONITORING SYSTEM

All painting works shall be mentioned (sign writing) with date of completion and PO no. at site/structure. These would facilitate defects observations and would also be basis for evaluation of the painting contractor /paint system and manufacturer for future works.

7. 0 AREA CLASSIFICATION & RECOMMENDED PAINTING SCHEMES

A) PAINTING SYSTEMS USING Cu-SLAG BLASTING TO Sa 2.5 (Min. Profile 50 microns) AS SURFACE PREPARATION

SYSTEM – 1:

FOR EXTERNAL SURFACE OF VESSEL, EQUIPMENT / COLOUMN / PIPING, & ALL STRUCTURAL UP TO 100 ^{0}C TEMP.

(All areas in refinery including , Pipe Track No 14 , Pipe Track No. 9, SRU, ARU, CRU, FCCU (MEROX), CCU (Gas Treater), Pipe Track No. 7, CDU-VDU, HGU, Hydro Cracker, DHDS, New SRU, LOBS, DM Water Plant, Area, Pipe Track No. 4 & 5 (Along Road No. 4 Up To Road No. 5 & Along Road No. 5 Up to Road No. 6), MINAS, SWPH, FLARE, JETTY, Jawahar Island & Acid/Caustic Tanks).

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
P1	Inorganic Zinc Ethyl Silicate Primer	1 x65	Air Spray / Airless
F1	High build two pack polyamide cured epoxy	2 x 100	Spray / Brush
U1	Aliphatic acrylic modified high solids weather resistant recoatable two pack polyurethane (finish coat)	1 x 40	Spray / Roller/Brush
	Total DFT ⚠	**305**	

SYSTEM- 2:

OLD SEA WATER COOLING TOWER/RMP CT AROUND COOLING TOWER OF 100 M RADIUS (SALT WATER SPRAY AREA)

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
P1	Inorganic Zinc Ethyl Silicate Primer	1 x 65	Air Spray / Airless
F2	Low VOC (Volatile Organic Compounds) two component internally flexibilised high build surface tolerant epoxy pigmented with Aluminium & Lamellar Micaceous Iron oxide coating	2 x 120	Spray/Brush
U1	Aliphatic acrylic modified high solids weather resistant recoatable two pack polyurethane (finish coat)	1 x 40	Spray/Roller/ Brush
	Total DFT	**345**	

Note: Salt water spray areas will require fresh water blasting or fresh water (Max. Chloride content 50 ppm) mopping shall be carried out on Salt Water spray areas, before application of primer, to remove the salts deposited on metal surface. Mopping can be repeated before application of other coats to remove salts deposited on previous coats, if such deposits are suspected.

SYSTEM-3:

FOR INSULATED EQUIPMENTS/VESSELS/COLUMNS/PIPELINES UPTO 200 ^{0}C TEMP.

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
T8	Two component high solid High temperature (up to 200deg c dry heat) Phenolic CUI (corrosion under insulation) epoxy coating.	2 x 125	Spray /Brush
	Total DFT	**250**	

SYSTEM-4: ⚠

FOR INSULATED NON-CRITICAL EQUIPMENT AND PIPELINES FROM 200 ^{0}C TO 400 ^{0} C TEMP.

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
P1	Inorganic Zinc Ethyl Silicate Primer	1 x 65	Air Spray / Airless
	AND		
T4	Oleo resinous based heat resistant Aluminium paint (Temperature Resistance:250 ^{0}C)	2 X 25	Brush
	OR		
T6	Silicon Based Heat Resistant Aluminum Paint. (Temperature Resistance :from 250 to - 400 ^{0}C)	2 x 20	Brush
	Total DFT	**115/105**	

SYSTEM - 5: ⚠

FOR INSULATED NON-CRITICAL EQUIPMENT AND PIPELINES FROM 400 ^{0}C TO 540 ^{0} C TEMP.

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
T6	Silicon Based Heat Resistant Aluminum Paint.	3 x 20	Brush

SYSTEM – 6: ⚠

FOR INSULATED CRITICAL EQUIPMENT (CARBON STEEL, LTCS, LOW ALLOY STEEL) LIKE VESSELS/RACTORS/COLUMNS/ EQUIPMENTS 200 ^{0}C TO 540 ^{0} C TEMP.

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
TSA	Thermal spray Aluminium coating (TSAC) Refer Annexure – G	250	TSAC

SYSTEM - 7:

FOR UN INSULATED EQUIPMENTS/ VESSELS/ COLOUMNS/ PIPE LINES / FURNACES FROM 100 ^{0}C TO 400 ^{0}C TEMP.

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
P1	Inorganic Zinc Ethyl Silicate Primer	1 x 65	Air Spray / Airless
	AND		
T4	Oleo resinous based heat resistant Aluminium paint (Temperature Resistance:250 ^{0}C)	2X25	Brush
	OR		
T6	Silicon Based Heat Resistant Aluminum Paint. (Temperature Resistance :from 250 to 400 ^{0}C)	2 x 20	Brush
	Total DFT	**115/105**	

SYSTEM - 8:

FOR UN INSULATED EQUIPMENTS/ VESSELS/ COLOUMNS/ PIPE LINES / FURNACES FROM 400 ^{0}C TO 540 ^{0}C TEMP.

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
T6	Silicon Based Heat Resistant Aluminum Paint.	2 x 20	Brush

SYSTEM - 9:

FOR INSULATED/UNINSULATED ABOVE 100 DEG C TURBINES, COMPRESSORS, BLOWERS, STACKS.

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
T2	Bituminous Stack Black (Temperature Resistance:200 ^{0}C **)**	2 x 35	Brush
	OR		
T3	Zinc Dust Graphite Paint (Temperature Resistance:450 ^{0}C **)**	2 x 30	Brush
	Total DFT	**70/60**	

SYSTEM- 10: ⚠

UNDERGROUND, UNDER SOIL (BURIED) PIPELINES UP TO 50 DEG C FOR OTHER THAN PLANT AREA i. e. EXCLUSIVELY FOR OFFSITE AREA

Generic name of the coating	Thickness (mm)	Method of Application
Anti Corrosive Tape	2 x 2 mm	Manual
Total DFT	**4 mm**	

Notes:

1. Carry out shot blasting of the surface to Sa 2.5 finish.
2. Apply one coat of synthetic primer conforming to AWWA 203/2003 and IS 15337/2003 standards. The primer shall be compatible with the hot applied tape.
3. Use 2 layers of 2 mm thick each hot applied anti-corrosive tape conforming to AWWA 203/2003 and IS 15337/2003 standards.
4. Both the primer and tape shall be of one manufacturer for compatibility.
5. Ensure that the tape is tightly wound on the pipe.
6. Spirally wrap the self adhesive tape on the primed surface with 25 mm overlap.
7. The length of the tape shall be kept sufficiently extra to complete the length of the pipeline.
8. The spiral joint if any shall have 25 mm overlap.
9. The tape coated pipes and the field joint coated area shall be holiday tested using portable holiday tester using 12,000 volts.
10. Weld joints shall be coated only after hydro test.

SYSTEM - 11:

UNDERGROUND, UNDER SOIL (BURIED) PIPELINES / STRUCTURES/VESSELS ⚠ UP TO 100 DEG C

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
P2	Epoxy red oxide zinc phosphate primer	1 x 60	Spray
F3	Epoxy Glass Flake (Amine Adduct)	2 x 200	Spray
	Total DFT	**460**	

SYSTEM - 12:

UNDERGROUND, UNDER SOIL (BURIED) PIPELINES / VESSELS FROM 100 TO 480 DEG. C FOR CS AND 600 DEG. C FOR SS SURFACES. ⚠

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
T9	Heat resistant Engineered Polysiloxane	3x125	Spray
	Total DFT	**375**	

B) PAINTING SYSTEMS USING MANUAL CLEANING TO St2 OR POWER TOOL CLEANING TO St3 AS SURFACE PREPARATION.

SYSTEM – 13:

FOR EXTERNAL SURFACE OF VESSEL, EQUIPMENT / COLOUMN / PIPING / ALL STRUCTURAL UP TO 100 ^{0}C TEMP.

(All areas in refinery including, Pipe Track No 14 , Pipe Track No. 9, SRU, ARU, CRU, FCCU (MEROX), CCU (Gas Treater), Pipe Track No. 7, CDU-VDU, HGU, Hydro Cracker, DHDS, New SRU, LOBS, DM Water Plant, Pipe Track No. 4 & 5 (Along Road No. 4 Up To Road No. 5 & Along Road No. 5 Up to Road No. 6), MINAS, SWPH, FLARE, JETTY, Jawahar Island & Acid/Caustic Tanks).

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
P4	Self Priming surface tolerant Epoxy Mastic Paint	1 x 125	Brush
F1	High build two pack polyamide cured epoxy.	1 x 125	Brush
U1	Aliphatic acrylic modified high solids weather resistant recoatable two pack polyurethane (finish coat)	1 x 40	Roller/ Brush
	Total DFT ⚠	**290**	

SYSTEM - 14:

OLD SEA WATER COOLING TOWER/RMP CT AROUND COOLING TOWER OF 100 M RADIUS (SALT WATER SPRAY AREA)

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
P4	Self Priming Epoxy Mastic Paint	1 x 125	Brush
F2	Low VOC (Volatile Organic Compounds) two component internally flexibilised high build surface tolerant epoxy pigmented with Aluminium & or Lamellar Micaceous Iron oxide coating	1 x 125	Brush
U1	Aliphatic acrylic high solids weather resistant recoatable two pack polyurethane (finish coat)	1 x 40	Roller/ Brush
	Total DFT	**290**	

Note: Salt water spray areas will require fresh water blasting or fresh water (Max. Chloride content 50 ppm) mopping shall be carried out on Salt Water spray areas, before application of primer, to remove the salts deposited on metal surface. Mopping can be repeated before application of other coats to remove salts deposited on previous coats, if such deposits are suspected

SYSTEM-15:

FOR ALL AREAS IN REFINERY EXCEPT ABOVE INCLUDING PUMPS / MOTORS / BLOWERS /ELECTRICAL PANELS

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
P4	Self Priming Epoxy Mastic Paint	1 x 125	Brush
U1	Aliphatic acrylic modified high solids weather resistant recoatable two pack polyurethane (finish coat)	1X40	Brush
	Total DFT	**165**	
	OR		
P2	Epoxy Red Oxide Zinc Phosphate Primer	1 x 60	Brush
B1	Synthetic Enamel Paint	2 x 25	Brush
	Total DFT	**110**	

SYSTEM – 16:

FOR INSULATED EQUIPMENTS / VESSELS / COLUMNS / PIPELINES UPTO 200 ^{0}C TEMP.
Note: SURFACE PREPARATION (Cu-SLAG BLASTING TO Sa 2.5 (Min. Profile 50 microns) ⚠

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
T8	Two component high solid, High temperature(up to 200deg c dry heat) Phenolic CUI (corrosion under insulation) epoxy coating	2 x125	Spray /Brush
	Total DFT	**250**	

SYSTEM – 17: ⚠

FOR INSULATED EQUIPMENTS / VESSELS / COLUMNS / PIPELINES WITH OUT HEAT TRACER BELOW 100 ^{0}C. (For recoating of existing similar type of paint system)

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
F2	Low VOC (Volatile Organic Compounds) two component internally flexibilised high build surface tolerant epoxy pigmented with Aluminium & Lamellar Micaceous Iron oxide coating	2 x 100	Spray/Brush
	Total DFT	**200**	

SYSTEM – 18: ⚠

FOR INSULATED EQUIPMENTS / VESSELS / COLUMNS / PIPELINES WITH HEAT TRACER Above 100 ^{0}C. (For recoating of existing similar type of paint system).

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
T3	Zinc Dust Graphite. (Temperature Resistance : up to 450 ^{0}C)	2 x 30	Brush
	Total DFT	**60**	

OR

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
T6	Silicon Based Heat Resistant Aluminum Paint. (Temperature Resistance :250 - 540 ^{0}C)	2 x 20	Brush
	Total DFT	**40**	

SYSTEM –19:

FOR UN INSULATED EQUIPMENTS / VESSELS / COLOUMNS / PIPE LINES / FURNACES ABOVE 200 ^{0}C TEMP.

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
T4	Oleo resinous Based Heat Resistant Aluminum Paint (Temperature Resistance: up to 250 ^{0}C)	2 x 25	Brush
T6	Silicon Based Heat Resistant Aluminum Paint (Temperature Resistance : 250 – 540 ^{0}C)	2 x 20	Brush
	Total DFT ⚠1	**50 / 50**	

SYSTEM – 20:

FOR INSULATED/ ⚠1 UN-INSULATED TURBINES / COMPRESSORS/ BLOWERS / STACKS ABOVE 100 ^{0}C TEMP.

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
T2	Bituminous Stack Black (Temperature Resistance:200 ^{0}C **)**	2 x 35	Brush
	OR		
T3	Zinc Dust Graphite Paint (Temperature Resistance:450 ^{0}C **)**	2 x 40	Brush
	Total DFT	**70/80**	

C) <u>INTERNAL PAINTING OF EQUIPMENT AND STOTRAGE TANKS – Cu-SLAG BLASTING TO Sa 2.5 (Min. Profile 50 microns) AS SURFACE PREPARATION</u>

<u>SYSTEM – 21</u>:

FOR EQUIPMENT – STEAM DRUM/STEAM CONDENSATE POT

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
T1	Boiler composition interior paint(hot wet metal surface)	2 x 35	Brush
	Total DFT	70	

<u>SYSTEM – 22</u>*:*

FOR OVERHEAD PRODUCT ACCUMULATIONS EQUIPMENTS

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
P2	Epoxy red oxide zinc phosphate primer	1x60	Spray
F10	Epoxy Glass Flake (Amine Adduct)	1 x 200	Spray
	Total DFT	**260**	

<u>SYSTEM – 23</u>:

FOR EQUIPMENTS-KOD/AIR VESSEL (NORMALLY BOTTOM SECTION), VESSELS CARRYING SALT WATER, EXCHANGER TUBE SHEETS, FLOAT HEAD, CHANNEL AND CHANNEL COVERS OF NON-FERROUS COOLERS & CONDENSERS.

Note : Surface preparation St2, St3 (manual/power tool cleaning shall be accepted as suit to site condition)

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
F7	Epoxy Coal Tar Paint	2 x 100	Brush
	Total DFT	**200**	

SYSTEM – 24: ⚠

EXCHANGER TUBE SHEET, FLOAT HEAD, CHANNEL AND CHANNEL COVERS OTHER THAN NON-FERROUS COOLERS & CONDENSERS.

Note: Surface preparation Sa 2.5

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
F9	Solvent free amine cured epoxy reinforced with glass flakes.	2 x 500	Spray
	Total DFT	**1000**	

SYSTEM – 25:

FOR LPG MOUNDED BULLETS (only from 4'O clock to 8'O clock position area)

Note: Application of primer shall be as per Manufacturer's Specifications. ⚠
In case the primer is not recommended by the paint manufacturer, then total DFT of the finished paint system shall be 660 microns

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
P6	Two Component polyamide cured epoxy primer.	1 X60	Spray
F5	Two Component solvent free amine cured epoxy coating.	2 X 300	Air less spray
	Total DFT	**660**	

D) OTHER PAINTING SYSTEMS:

SYSTEM- 26:

FOR GI SURFACES (EXCLUDING GALVANISED THICKNESS)

Note: surface preparation is only cleaning of dust/oil contamination.

Paint Type	PAINT TYPE	DFT (Microns)	Method of Application
P7	Epoxy red oxide zinc phosphate primer suitable for GI surfaces. ⚠	1X60	Brush/roller
U1	Aliphatic acrylic modified recoatable two pack polyurethane (finish coat)	1X40	Brush/roller
	Total DFT ⚠	100	

E) SPECIAL PAINTING / COATING SYSTEM

SYSTEM-27:

EXTERNAL THERMAL INDICATIVE PAINT FOR COLD COLLECTOR VESSELS OF REFORMER FURNACES (HGU & NHGU, FCCU REGENERATOR): ABRASIVE CU SLAG SHOT BLASTING TO SA 2.5.

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
P1	Inorganic Zinc Ethyl Silicate Primer	1x65	Air Spray / Airless
T10	A single pack, temperature indicating paint based upon a modified silicone (Intertherm 715 of AKZONBEL equivalent). (The colour to change from green to blue at temperatures between 180-220°C (356-428°F), and from blue to white at temperatures between 310-350°C (590-662°F).	2X25	Air spray
	Total DFT	**115**	

SYSTEM-28 :

SEA COOLING WATER SERVICE INTERNAL LINING OG 30"NB DIA AND ABOVE IN RMP UNITS: SURFACE PREPARATION: ABRASIVE CU SLAG SHOT BLASTING TO SA 2.5

Note: Application of primer shall be as per Manufacturer's Specifications.
In case the primer is not recommended by the paint manufacturer, then total DFT of the finished paint system shall be 1065 microns
Detail procedure shall get approved from BPCL inspection in line with indicative system.

Paint Type	Generic name of the paint	DFT (Microns)	Method of Application
P1	Inorganic Zinc Ethyl Silicate Primer	1 x 65	Spray
F9	Solvent free, epoxy cured with polyamine/modified polyamine/polyamine adduct coating reinforced with glass fibre/flakes. SIGMAA SHIELD 905 of Sigma coatings, INTERLINE 925 GF of Akzo Nobel, or equivalent as approved.	2X500	Spray
	Total DFT	**1065**	

8.0 DETAILED PAINT SPECIFICATIONS

8.1 LIST OF PRIMERS & FINISH PAINTS ⚠

Note: For all internal lining / internal painting works, manufacturer's laboratory test statement / Laboratory Paint performance certificates to be submitted by paint manufacturers & checked apart from material test certificates for specified services at operating temperature and condition. Material shall be procured from only those approved manufacturers who will meet the above stated criteria.

SR. NO.	PRIMER	PAINT TYPE	SPECIFIED VOL. SOLIDS
1	Inorganic Zinc ethyl silicate primer (Minimum 85% Zinc dust by weight in the dried film)	P1	60 ± 2 %
2	Epoxy red oxide zinc phosphate primer	P2	50 ± 2 %
3	Self priming surface tolerant epoxy mastic paint	P4	80 ±2 %
4	Amine Adduct Cured Epoxy Holding Primer	P5	60 ± 3 %
5	Two Component Polyamide cured Epoxy Primer	P6	57%±2 %
6	Epoxy red oxide zinc phosphate PRIMER SUITABLE FOR GI SURFACE	P7	50 ± 3 %
	FINISH PAINTS		
7	High build two pack ployamide cured epoxy	F1	60± 2%
8	Low VOC High build Surface tolerant Epoxy pigmented with Al, Micaceous iron oxide	F2	80%
9	Epoxy glass flake paint (amine adduct -Buried Pipelines)	F3	87 ± 3%
10	Two pack Epoxy based **tank liner** (Amine cured)	F4	60 ± 2 %
11	Two Component solvent free amine cured epoxy (Immersion services)	F5	100%
12	Solvent Free Epoxy amine cured (Potable Water)	F6	100%
13	Epoxy coal tar paint (Immersion Grade)	F7	64 ± 2%
14	Solvent free amine cured epoxy reinforced with glass flakes. (Sea Water Pipeline internal)	F9	100
15	Epoxy glass flake paint (amine adduct)(IMMERSION SERVICES)	F10	90 ± 3%
	HIGH TEMPERATURE PAINTS		
16	Boiler composition	T1	40 ± 2 %
17	Bituminous stack black	T2	40 ± 2 %
18	Zinc dust graphite paint	T3	40 ± 2 %
19	Oleoresinous based heat resistant Aluminium paint (up to 250 deg. C)	T4	30 ± 2 %

SR. NO.	PRIMER	PAINT TYPE	SPECIFIED VOL. SOLIDS
20	Silicone Heat resistant Aluminum paint (400 - 600 deg. C)	T6	28 ± 2 %
21	Two component high solid, high temperature phenolic CUI (corrosion under insulation Epoxy coating (UP TO 200 DEG. C)	T8	67 ± 2%
22	Heat resistant Engineered Polysiloxane	T9	75 ± 2%
23	Temperature indicating paint based upon modified silicone	T10	42 ± 2%
24	Two component high solid High temperature **(suitable up to minimum 120 deg C. immersed heat)** phenolic / phenolic novalac epoxy coating.	T11	67 ± 2%
	POLYURETHANE PAINTS		
25	Acrylic Aliphatic weather resistant recoatable polyurethane paint	U1	50±2%
	ALKYD BASED PAINT		
26	Synthetic enamel paint	B1	40 ± 2 %
27	Oil based Aluminium paint	B2	40 ± 2 %

For Brand Names Refer Annexure - I

8.2 PAINT SPECIFICATIONS

PDS: Product Data Sheets.

PRIMER

1) Inorganic Zinc Ethyl Silicate Primer (P1):

Colour	:	Grey
Finish	:	Matt
Type	:	2 pack inorganic ethyl silicate
Application	:	By brush or Airless spray
Dry film thickness/coat	:	60 – 70 µm
Pigment (main) ⚠	:	Minimum 85% Zinc dust by weight in the dried film
Volume solids	:	60 ± 2%
Area coverage (theoretical)	:	6 to 7 sq.m/litre
Surface dry	:	2 hrs.
Hard dry	:	24 hrs.
Over coating	:	As per Manufacturer's PDS
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS

Shelf life	:	As per Manufacturer's PDS
Temperature Resistance	:	400 ^{0}C

2) Epoxy Red Oxide Zinc Phosphate Primer (P2):

Colour	:	Red
Finish	:	Semi gloss
Application	:	Airless/Airspray/Brush
Pigment (main)	:	Zinc phosphate content minimum 5 – 10 % by weight of the total pigments
Type of epoxy	:	Condensation product of bisphenol – A and epichlorohydrin with terminal Epoxide groups.
Curing agent	:	Polyamide (amine value 210-230)
Volume solids	:	50 $\pm$ 2 %
DFT	:	60 - 70 microns
Area Coverage (Theoretical)	:	8 - 10 sq.m / litre
Surface dry	:	8 hrs.
Hard dry	:	24 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS

3) **Self Priming Surface Tolerant Epoxy Mastic Paint** (P4):

Colour	:	As desired
Finish	:	Semi-Glossy
Type	:	Two pack
Application	:	By brush or Airless spray
Dry film thickness/coat	:	100 – 125 µm
Volume solids	:	80 ±2 %
Area coverage (theoretical)	:	6.5 to 8 sq.m/litre
Surface dry	:	6 hrs.
Hard dry	:	16 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS

4) Amine /Amine Adduct Cured Epoxy Holding Primer (P5):

Colour	:	Red brown / greenish grey /self standard
Finish	:	Low Metallic Sheen
Type	:	Two pack
Application	:	By brush or Airless spray

Dry film thickness/coat	:	60 µm
Volume solids	:	60 ±3 %
Area coverage (theoretical)	:	12 sq.m/litre
Surface dry	:	2 hrs.
Hard dry	:	16 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS

5) Two Component Polyamide Cured Epoxy Holding Primer : (P6):

Colour	:	Yellow / Green /self standard
Finish	:	Egg shell
Type	:	Two Packs
Application	:	Airless Spray, Air Spray, Brush, Roller
DFT per coat	:	60 microns
Volume Solids ⚠	:	57 $\pm$ 3 %
Theoretical Coverage	:	11.4M² / Lt. @ 50 µ DFT
Surface Dry (25 Deg C)	:	1.5 hrs.
Hard Dry (25 Deg C)	:	16 hrs.
Minimum Over coating Time	:	As per Manufacturer's PDS
Maximum Over coating Time	:	As per Manufacturer's PDS
Shelf Life	:	As per Manufacturer's PDS

6) Epoxy Red Oxide Zn Phosphate Primer Suitable For GI Surfaces: (P7):

Colour	:	Red
Finish	:	Semi gloss
Application	:	Airless/Airspray/Brush
Pigment (main) ⚠	:	Zinc phosphate content minimum 5 – 10 % by weight of the total pigments
Type of epoxy	:	Condensation product of bisphenol – A and epichlorohydrin with terminal Epoxide
Curing agent	:	Polyamide (amine value 210-230)
Volume solids	:	50 $\pm$ 3 %
DFT	:	60 - 70 microns
Area Coverage (Theoretical)	:	8 - 10 sq.m / litre
Surface dry	:	8 hrs.
Hard dry	:	24 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS

FINISHED PAINTS

7) High Build Two Pack Polyamide Cured Epoxy (F1):

Colour	:	White /Grey
Finish	:	Semi Gloss / Matt
Type	:	Two Packs
Application	:	By brush or Air/Airless spray
Dry film thickness/coat	:	100-150 μm
Volume solids	:	60± 2%
Area coverage (theoretical)	:	8 to 10 sq. m/ litre
Surface dry	:	4 hrs.
Hard dry	:	24 hrs.
Over coating	:	As per Manufacturer's PDS
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS

8) Low VOC High Build Surface Tolerant Epoxy Pigmented with Al & Micaceous Iron Oxide (F2):

Colour	:	Aluminum / Grey / Red
Finish	:	Egg Shell
Type	:	Two Packs
Application	:	Airless Spray, Air Spray, Brush, Roller
DFT per coat	:	125 ±25 microns
Volume Solids	:	80
Theoretical Coverage	:	5.30 square meters per liter at 150 microns DFT
Surface Dry (25 Deg C)	:	6 hrs
Hard Dry (25 Deg C)	:	16 hrs
Minimum Over coating Time	:	As per Manufacturer's PDS
Maximum Over coating Time	:	As per Manufacturer's PDS
Shelf Life	:	As per Manufacturer's PDS

9) Epoxy Glass Flake Paint (Amine Adduct) for Buried pipelines) (F3):

Colour	:	As desired
Finish	:	Semi-Glossy
Type	:	Two packs
Application	:	By brush or Airless spray
Dry film thickness/coat	:	200– 210 μm
Volume solids [1]	:	87 ± 3%
Area coverage (theoretical)	:	4 to 4. 5 sq.m/litre

Surface dry	:	8 hrs.
Hard dry	:	24 hrs.
Recoatability	:	As per Manufacturer's PDS
Over coating	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS

10) **Two Pack Epoxy Based Tank Liner (Amine Cured) (F4):**

Colour	:	White/Grey
Finish	:	matt
Type	:	Two pack
Application	:	By brush or Airless spray
Volume solids	:	60 $\pm$ 2%
Type of epoxy	:	Condensation product of bisphenol-A and epichlorohydrin with terminal epoxide groups.
Dry film thickness /coat	:	75 - 125 microns
Spreading rate	:	4 – 5 sq.m / litre
Surface dry	:	2-3 hrs.
Hard dry	:	16-24 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS

11) Two Component Solvent Free Amine Cured Epoxy Immersed Services (F5):

Colour	:	Green / Off white
Finish	:	Glossy
Type	:	Two Packs
Application	:	Airless Spray, Air Spray
DFT per coat	:	300 µ
Volume Solids	:	100 %
Theoretical Coverage	:	3.3 M^2 / Lt. @ 300 µ DFT
Surface Dry (25 Deg C)	:	8 hrs.
Hard Dry (25 Deg C)	:	24 hrs
Minimum Over coating Time	:	As per Manufacturer's PDS
Maximum Over coating Time	:	As per Manufacturer's PDS
Shelf Life	:	As per Manufacturer's PDS

12) Solvent Free Epoxy Amine Cured (Potable Water Certificate) ⚠ (F6):

Colour	:	green / white
Finish	:	Glossy / semi gloss
Type	:	Two pack
Application	:	By brush or Airless spray
Dry film thickness/coat	:	300 µm
Volume solids	:	100 %
Area coverage (theoretical)	:	3.3 sq.m/litre
Surface dry	:	8 hrs.
Hard dry	:	16 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS

13) Epoxy Coal Tar Paint Immersion Grade (F7):

Colour	:	Brown/Black
Finish	:	Egg shell
Application	:	Airless / Airspray / Brush
Volume solids	:	64 $\pm$ 2%
Coaltar content	:	35 - 40% by volume
DFT	:	90-120 microns
Area Coverage (Theoretical)	:	5-7 sq.m / litre
Surface dry	:	8 hrs.
Hard dry	:	24 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS

14) Solvent Free Amine Cured Epoxy Reinforced With Glass Flakes: (F9):

Colour	:	Green - gloss
Type	:	Single pack
Application	:	Airless spray
Dry film thickness/coat	:	100 %
Volume solids	:	400-500 µm
Area coverage (theoretical)	:	2.5 sq.m/litre for 400 µm
Touch dry	:	8 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS

15) Epoxy Glass Flake Paint (Amine Adduct)(Immersion services) (F10):

Colour	:	As desired
Finish	:	Semi-Glossy
Type	:	Two packs
Application	:	By brush or Airless spray
Dry film thickness/coat	:	200– 210 µm
Volume solids	:	90 ± 3%
Area coverage (theoretical)	:	4 to 4. 5 sq.m/litre
Surface dry	:	8 hrs.
Hard dry	:	24 hrs.
Recoatability	:	As per Manufacturer's PDS
Over coating	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS

HIGH TEMPERATURE PAINTS

16) Boiler Composition (T1):

Colour	:	Black
Finish		Matt
Type		Single pack
Application		Brush
Volume solids		40 ± 2 %
Pigment content		34% +/- 2%
Binder content		26% +/- 2%
Temperature resistance (WET)		540^0 C.
DFT		35-40 microns
Area Coverage (Theoretical)		11-14 sq.m / litre
Surface dry		4-6 hrs.
Hard dry		24 hrs.
Recoatability		As per Manufacturer's PDS
Full cure		As per Manufacturer's PDS
Shelf life		As per Manufacturer's PDS

(The tests shall conform to IS 101 - 1964.)

Note: ⚠

After hard dry time filled the equipment with water and raised the temp up to 100 deg. C and hold it for 8 hrs for complete curing of product.

17) Bituminous Stack Black (T2):

Colour	:	Black
Finish	:	Matt
Type	:	Single pack
Application	:	Brush
Volume solids	:	40 ± 2 %
DFT	:	30-40 microns
Area Coverage (Theoretical)	:	11-14 sq.m / litre
Surface dry	:	4 hrs.
Hard dry	:	48 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS
Temperature Resistance	:	200 ^{0}C

18) Zinc Dust Graphite Paint (T3):

Colour	:	Grey
Finish	:	Matt
Application	:	Brush / Spray
Zinc dust	:	31 ±2 % by wt.
Graphite	:	24 ±2 %
Volume Solids	:	40 ±2 %
DFT	:	40-45 microns
Area Coverage (Theoretical)	:	10-11 sq.m /litre
Surface dry	:	12 hrs.
Hard dry	:	12-14 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS
Temperature Resistance	:	450 ^{0}C

19) Oleoresinous Based Heat Resistant Aluminium Paint (T4):

Colour	:	Metallic
Finish	:	glossy
Type	:	Two pack
Application	:	Air spray/Brush
Volume solids	:	30 ± 2 %
Aluminium content	:	23-25 %
DFT	:	20-25 microns
Area Coverage (Theoretical)	:	19-22 sq.m / litre
Surface dry	:	4 hrs.

Hard dry	:	16 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS
Temperature Resistance	:	250 ^{0}C

20) Silicone Heat Resistant Aluminum Paint (T6):

Colour	:	Grey
Finish	:	Semi gloss
Application	:	Airless/Airspray/Brush
Volume solids	:	28 ± 2 %
DFT	:	20-25 microns
Area Coverage (Theoretical)	:	11-14 sq.m / litre
Surface dry	:	2 hr.
Hard dry	:	16 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS
Temperature Resistance	:	400 – 600 ^{0}C

21) Two Component High Solid, High Temperature Phenolic CUI (Corrosion Under Insulation) **Epoxy Coating (T8):**

Colour	:	Buff, light grey
Finish	:	Matt
Type	:	Two pack
Application	:	By brush or Airless spray
Dry film thickness/coat	:	80-125µm
Volume solids	:	67± 2 %
Area coverage (theoretical)	:	5-8 sq.m/litre
Surface dry	:	6 hrs.
Hard dry	:	16 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS
Dry heat	:	up to 200deg c

22) Heat Resistant Engineered Polysiloxane – (T9):

Colour	:	Grey
Finish	:	Glossy
Type	:	Two pack

Application	:	By brush or Airless spray
Dry film thickness/coat	:	125-200 µm
Volume solids	:	75± 2 %
Area coverage (theoretical)	:	6 sq.m/litre for 125 µm
Surface dry	:	4 hrs.
Hard dry	:	5 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS
Dry heat	:	up to 600 deg c

Note:
(Holiday testing is not reliable due to presence of metallic pigments) ⚠

23) Temperature Indicating Paint Based Upon Modified Silicone (T10):

Colour	:	Green (at ambient temperature)
Finish	:	Eggshell
Application	:	Airless/Airspray/Brush
Volume solids	:	42 ± 2 %
DFT	:	20-25 microns
Area Coverage (Theoretical)	:	16 sq.m / litre
Surface dry	:	1 hr.
Hard dry	:	3 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS

24) Two Component High Solid, High Temperature Phenolic / phenolic novalac Epoxy Coating Suitable up to Minimum 120 Deg. C Immersion Services (T11):

Colour	:	Buff, light grey
Finish	:	Matt
Type	:	Two pack
Application	:	By brush or Airless spray
Dry film thickness/coat	:	80-125µm
Volume solids	:	67± 2 %
Area coverage (theoretical)	:	5-8 sq.m/litre
Surface dry	:	6 hrs.
Hard dry	:	16 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS
Immersed heat	:	up to 120 deg c

25. Acrylic Aliphatic Weather Resistant Polyurethane Paint: (U1)

Colour	:	As desired
Finish	:	Glossy
Type	:	Two packs
Application	:	By brush or Air/Airless spray
Dry film thickness/coat ⚠1	:	40– 50 µm
Volume solids ⚠1	:	50±2%
Area coverage (theoretical)	:	7 to 11 sq.m/ litre
Surface dry	:	1.5 hrs
Hard dry	:	6 hrs.
Over coating	:	As per Manufacturer's PDS
Recoatability	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS

ALKYD BASED PAINT

26) Synthetic Enamel Paint: (B1)

Colour	:	As desired
Finish	:	glossy
Application	:	Airless/Airspray/Brush
Volume solids	:	40 ± 2 %
DFT	:	25-35 microns
Area Coverage (Theoretical)	:	11.4-16.0 sq.m / litre
Surface dry	:	4 hrs.
Hard dry	:	12 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS
Shelf life	:	As per Manufacturer's PDS

27) Oil Based Aluminium Paint: (B2)

Colour	:	Metallic
Finish	:	Semi gloss
Application	:	Airless/Air spray/Brush
Volume solids	:	40 ± 2 %
Aluminium content	:	23-25 %
DFT	:	20-25 microns
Area Coverage (Theoretical)	:	15-20 sq.m / litre
Surface dry	:	4 hr.
Hard dry	:	16 hrs.
Recoatability	:	As per Manufacturer's PDS
Full cure	:	As per Manufacturer's PDS

9.0 BUILDING PAINTS

This section covers various building paints and also concrete and rebar coating

UNDERGROUND SURFACE
All under-ground surfaces shall be coated with 2 coats of coal tar epoxy

PLANT CONCRETE SURFACE:
Premium acrylic Anti carbonate painting (Sunext-8 of M/s Sunanda chemicals or equivalent) of four coats on fresh surface; 2 coats on old surface.(note: after scrap cleaning fill the cracks cavities with suitable polymer mortar like Poly fill AR/Polyalk EP.

BUILDINGS & SHEDS

TABLE – 3:

TYPE	Sheds	Other buildings	**Important Buildings such as admin. bldg., control rooms, main gate house etc.**
Building external	Cement based paint- 2 coats over a coat of primer.	Cement based sandtex mat- 2 coats over a coat of primer.	Antifungal, anti-algae acrylic copolymer paint
Building internal	Flat oil paint – 2 coats over a coat of primer.	Acrylic distemper – 2 coats over 2 coats of solvent thinnable primer.	Acrylic emulsion/ plastic emulsion – 3 coats over 2 coats of solvent thinnable primer.
Building ceiling	Flat oil paint – 2 coats over a coat of primer.	Acrylic distemper – 2 coats over 2 coats of solvent thinnable primer	Acrylic distemper – 2 coats over 2 coats of solvent thinnable primer
Metal surface	Synthetic enamel – 2 coats over a coat of primer.	Anodizing / powder coating	Anodizing / powder coating
Wooden surface	Synthetic enamel – 2 coats over a coat of wooden primer.	French polish –min.2 coats or Synthetic enamel – 2 coats over a coat of wood primer.	French polish –min. 2 coats or Synthetic enamel – 2 coats over a coat of wood primer.
AC sheets (Ver-tical Cladding) ⚠1	Antifungal, anti-algae acrylic copolymer paint		
Cooilng water sump/basin	Coal tar epoxy-2 coats		

10.0 STANDARD FOR COLOUR CODING OF PIPELINES/EQUIPMENTS

Non-uniformity of colour coding of pipelines in industrial installations causes faulty manipulation of valves, cutting of lines, welding on line carrying hazardous or inflammable material etc. resulting in to the destruction of property and injury to personnel. Uniformity of colour promotes greater safety, lessens the chances of error and warns against the hazards involved in the handling of material inside the pipelines.

Identification of the particular contents of the pipelines is achieved by imposing suitable colour bands on the ground colour. Letter writing as a mode of identification, is also recommended for chemical industry, as this will reduce the possibility of mistakes in identification. Lettering may include the contents by name, chemical formula, or unmistakable and standard abbreviations.

10.1 This standard prescribes the colour scheme for the identification of the contents of pipelines carrying fluids in the BPCL refinery.

This standard is not applicable to pipelines buried underground or used for electrical services.

PAINTS

Appropriate quality of paints conforming to relevant BPCL standards, wherever they exist, shall be used for colour marking.

It is recommended that the paints used should produce a glossy finish.

COLOURS

In order to identify the contents of the pipelines, a large number of colour shades are required. Recommendations regarding shades of colour that may be used are given in Table 4. Colours used should be near to the specified colour shade as possible.

TABLE – 4: DISTINCT SHADES OF COLOURS TO BE USED FOR CODING

SHADE NO. AND ITS DESCRIPTION ACCORDING TO IS 5 – 2007.

COLOUR	SHADE NO.
Black	Black
Blue	108 Aircraft Blue 174 Orient Blue
Brown	412 Dark Brown 413 Salmon Pink 414 Golden Brown
Grey	692 Smoke Grey
Orange	592 international orange

Red	536 Fire Red 537 Signal Red
Violet	796 Dark Violet
Yellow	309 Canary Yellow 358 Light Buff 362 Middle Stone
White	White

IDENTIFICATION

The system of colour coding consists of ground colour and colour bands superimposed on it.

Ground colour

The ground colour identifies the basic nature of the fluid carried in the pipeline.

Colour Bands

Colour bands are superimposed on the ground colour to distinguish

a. one kind or condition of a fluid from another kind or condition of the same fluid, or
b. one fluid from another but belonging to the same group.

APPLICATION

Ground colour

Colour as given in Table III (wherever only one colour is mentioned) shall be applied throughout the entire line including valves, junctions, joints, bends, service appliances, bulkheads, etc.

Colour Bands

They shall be superimposed on the ground colour.

The recommended size of the colour bands is given in table - 5.

TABLE – 5:

Outside Diameter of pipe or Covering **Inch**	**Width of the band** **mm.**	**Distance between set of Bands** **m.**
1 to 3 inches	50	5
Above 3 to 12 inches	50	10
Above 12 to 24 inches	100	15
Above 24 inches	200	20

The minimum gap shall be of 50mm between adjacent band.

For hot lines, which are insulated, painting of bands should be done in plain Aluminium sheet, which can be easily screwed to the pipeline.

Valves shall be painted with the same colour as the main pipelines except the valves shall be painted red for firefighting; yellow with black diagonal strips for warning of danger and Brilliant green colour, to denote pipes carrying fresh water, either potable or non-potable.
The colour coding as prescribed in this standard for pipelines in BPCL refinery for general services, process pipelines and pipelines conveying industrial gases (except pipelines conveying medical gases) are given in Table – III.

ADDITIONAL IDENTIFICATION

When further identification is required, this may be done as per the requirement of Operation Department.

10.2 Lettering

The recommended size of lettering for pipes of different diameters is given in table – 6.

TABLE - 6

Outside Diameter of pipe or Covering mm.	Size of legend mm.
20 to 30	10
Above 30 to 50	20
Above 50 to 80	30
Above 80 to 150	40
Above 150 to 250	63
Over 250	90

Direction of Flow

Where it is required to indicate the direction of flow, arrows or letters may be painted near valves, junctions, walls etc. and at suitable intervals along the pipe. These shall be black or white in colour and in contrast to the colour on which they are superimposed. If a label or badge with codified indication is attached to the pipe, the direction of flow may be indicated by the pointed end of the label or badge.

VISIBILITY MARKINGS

Attention would be given to the visibility of colour markings and the letters. Where the pipelines are located above the normal line of vision of the operator, the lettering should be placed below the horizontal line of the pipe.

10.3 TABLE – 7: COLOUR CODE FOR PIPE LINES/EQUIPMENT IN BPCL REFINERY (All colour code bands /sign writing shall be with synthetic enamel paint)

A. UTILITES:

Sr. No.	DESCRIPTION OF THE PRODUCT	GROUND COLOUR	COLOUR BANDS
1.	FIRE WATER	FIRE RED (No.536)	NIL
2.	COOLING WATER	SEA GREEN (No.217)	NIL
3.	RAW/DOMESTIC WATER	BRILLIANT GREEN (No.221)	NIL
4.	DM WATER	ALUMINIUM	1 BRILLIANT GREEN (No.221)
5.	BFW/CONDENSATE	ALUMINIUM	2 BRILLIANT GREEN (No.221)
6.	DRINKING WATER	ALUMINIUM	3 BRILLIANT GREEN (No.221)
7.	INSTRUMENT AIR	AIR CARFT BLUE (No.108)	NIL
8.	PLANT AIR	ORIENT BLUE (No.174)	NIL
9.	NITROGEN	CANARY YELLOW (No.309)	1 BLACK BAND
10	15 KG STEAM	ALUMINIUM	2 SIGNAL RED (No.537)
11.	3.5 KG STEAM	ALUMINIUM	4 SIGNAL RED (No.537)
12.	1.0 KG STEAM	ALUMINIUM	5 SIGNAL RED (No.537)
13.	FLARE	ALUMINIUM	CANARY YELLOW (No.309)

B. PRODUCT RUNDOWN:

Sr. No.	DESCRIPTION OF THE PRODUCT	GROUND COLOUR	COLOUR BANDS
1.	FUEL GAS	CANARY YELLOW (No.309)	NIL
2.	LPG	ALUMINIUM	2 CANARY YELLOW (No. 309)
3.	C3 STREAM	ALUMINIUM	1 CANARY YELLOW (No. 309)
4.	C4 STREAM	ALUMINIUM	3 CANARY YELLOW (No. 309)
5.	GASOLINE	SALMON PINK (No.443)	NIL
6.	KEROSENE	SMOKE GREY (No.692)	NIL
7.	ATF	ALUMINIUM	4 ORIENT BLUE (No.174)
8.	MT	ALUMINIUM	4 SMOKE GREY (No.692)
9.	HSD	LIGHT BUFF (No.358)	NIL
10	SBP 55/115	MIDDLE STONE (No.362)	NIL
11	SBP 64/69	ALUMINIUM	1 MIDDLE STONE (No.362)
12	BENZENE	WHITE	NIL
13	TOULENE	WHITE	4 MIDDLE STONE (No.362)
14	SLOPS	SMOKE GREY (No.692)	1 BLACK
15	LSHS/FO/CLO	ALUMINIUM	3 BLACK
16	NAPHTHA	ALUMINIUM	1 SALMON PINK (No.443)

C. CHEMICALS:

Sr. No.	DESCRIPTION OF THE PRODUCT	GROUND COLOUR	COLOUR BANDS
1.	CAUSTIC	ALUMINIUM	1 DARK VIOLET (No.796)
2.	HCL ACID	ALUMINIUM	2 DARK VIOLET (No.796)
3.	H_2SO_4 ACID	ALUMINIUM	3 DARK VIOLET (No.796)
4.	OTHERS	DARK VIOLET (No.796)	NIL

D. CRUDE DISTILLATION COMPLEX:

Sr. No.	DESCRIPTION OF THE PRODUCT	GROUND COLOUR	COLOUR BANDS
1.	CRUDE	ALUMINIUM	NIL
2.	LPG	ALUMINIUM	2 CANARY YELLOW (No.309)
3.	D4 BOTTOMS – HOT – COLD	ALUMINIUM	1 SALMON PINK (No.443)
4.	HEAVY NAPTHA/SCN	ALUMINIUM	4 SALMON PINK (No.443)
5.	LK – 1	ALUMINIUM	1 SMOKE GREY (No.692)
6.	LK – II	ALUMINIUM	2 SMOKE GREY (No.692)
7.	Hy KERO/HCP KERO	ALUMINIUM	3 SMOKE GREY (No.692)
8.	GO – I / LGO	ALUMINIUM	1 DARK BROWN (No.412)
9.	GO – III /HGO	ALUMINIUM	3 DARK BROWN (No.412)
10.	GO – IV	ALUMINIUM	4 DARK BROWN (No.412)
11.	LR	ALUMINIUM	1 BLACK
12.	VGO	ALUMINIUM	2 BLACK
13.	SR	ALUMINIUM	3 BLACK
14.	FO Ex B/H	ALUMINIUM	4 NOS. BLACK

E. AROMATICS COMPLEX:

Sr. No.	DESCRIPTION OF THE PRODUCT	GROUND COLOUR	COLOUR BANDS
1.	RFU FEED	ALUMINIUM	1 SALMON PINK (No.443)
2.	SPLITER – TOPS / IBP-60	ALUMINIUM	1 SALMON PINK (No.443) & 1 CANARY YELLOW (No.309)
3.	SPLITTER – 2 TOPS/REFORMER FEED/ DSN	ALUMINIUM	2 SALMON PINK (No.443)
4.	SPLITER – 2 BOTTOMS	ALUMINIUM	4 SMOKE GREY (No.692)
5.	C3/C4	ALUMINIUM	2 CANARY YELLOW (No.309)
6.	STABILIZER GAS	CANARY YELLOW (No.309)	NIL

7.	REFORMATE/ARU FEED	ALUMINIUM	3 SALMON PINK (No.443)
8.	RAFFINATE	ALUMINIUM	2 MIDDLE STONE (No.362)
9.	EXTRACT	ALUMINIUM	3 MIDDLE STONE (No.362)
10.	SULFOLANE	ALUMINIUM	1 INTERNATIONL ORANGE (No.592)
11.	HOT OIL	ALUMINIUM	1 SIGNAL RED (No.537) & 1 BLACK
12.	PROCESS WATER	ALUMINIUM	4 BRILLIANT GREEN (No.221)
13.	BENZENE	WHITE	WHITE
14.	TOLUENE	WHITE	4 MIDDLE STONE (No.362)
15.	MTBE	WHITE	2 MIDDLE STONE (No.362)
16.	HYDROGEN	CANARY YELLOW (No.309)	1 SIGNAL RED (No.537)
17.	SOUR GAS/H2S RICH GAS	CANARY YELLOW (No.309)	2 SIGNAL RED (No.537)
18.	METHANOL	WHITE	1 SIGNAL RED (No.537)
19.	DMDS	WHITE	2 SIGNAL RED (No.537)

F. CCU / FCCU COMPLEX:

Sr. No.	DESCRIPTION OF THE PRODUCT	GROUND COLOUR	COLOUR BANDS
1.	ACID GAS/H_2S RICH GAS	CANARY YELLOW (No.309)	2 SIGNAL RED (No.537)
2.	PROCESS WATER	ALUMINIUM	4 BRILLIANT GREEN (No.221)
3.	CC GASOLINE	SALMON PINK (No.443)	NIL
4.	IBP - 60	ALUMINIUM	WITH 1 SALMON PINK (No.443) & 1 CANARY YELLOW(No.309)
5.	LCO	ALUMINIUM	1 ORIENT BLUE (No.174) & 1 DARK BROWN (No.412)
6.	HCO	ALUMINIUM	1 ORIENT BLUE (No.174) & 2 DARK BROWN (No.412)
7.	VGO	ALUMINIUM	2 BLACK
8.	CLO/MCB/SLURRY	ALUMINIUM	3 BLACK
9.	CAT LOADING LINES	ZINC DUST GRAPHITE PAINT	NIL
10.	40 KG STEAM	ALUMINIUM	1 SIGNAL RED (No.537)
11.	5/7 KG STEAM	ALUMINIUM	3 SIGNAL RED (No.537)
12.	HYDRAULIC OIL / FLUSHINGOIL /GLAND SEAL OIL	WHITE	1 BRILLIANT GREEN (No.221)
13.	SOUR WATER	ALUMINIUM	4 BRILLIANT GREEN (No.221)
14.	DEA	WHITE	2 SIGNAL RED (No.537)
15.	L IQUID SULPHERS	WHITE	3CANARY YELLOW (No.309)

G. DHDS COMPLEX: ⚠

SR. NO.	DESRIPTION OF PRODUCT	GROUND COLOUR	COLOUR BANDS
1	HYDROGEN	CANARY YELLOW (No.309)	1 SIGNAL RED (No.537)
2	ACID GAS/H2S RICH GAS	CANARY YELLOW (No.309)	2 SIGNAL RED (No.537)
3	FUEL GAS	CANARY YELLOW (No.309)	NIL
4	NAPTHA	ALUMINIUM	1 SALMON PINK (No.443)
5	NITROGEN	CANARY YELLOW (No.309)	1 BLACK BAND
6	BFW/CONDENSATE	ALUMINIUM	2 BRILLIANT GREEN (No.221)
7	INSTRUMENT AIR	AIR CARFT BLUE (No.108)	NIL
8	PLANT AIR	ORIENT BLUE (No.174)	NIL
9	DIESEL	ALUMINIUM	1 LIGHT BUFF (No.358)
10	LIQUID SULPHERS	WHITE	3 CANARY YELLOW(No.309)
11	FIRE WATER	FIRE RED (No.536)	NIL
12	COOLING WATER	SEA GREEN (No.217)	NIL
13	SOUR WATER	ALUMINIUM	4 BRILLIANT GREEN (No.221)
14	AMINE	WHITE	2 SIGNAL RED(No. 537)
15	15 KG STEAM	ALUMINIUM	2 SIGNAL RED (No.537)
16	5/7 KG STEAM	ALUMINIUM	3 SIGNAL RED (No.537)
17	3.5 KG STEAM	ALUMINIUM	4 SIGNAL RED (No.537)
18	1.0 KG STEAM	ALUMINIUM	5 SIGNAL RED (No.537)
19	FLARE	ALUMINIUM	CANARY YELLOW (No.309)

H. CCR COMPLEX: ⚠

SR. NO.	DESRIPTION OF PRODUCT	GROUND COLOUR	COLOUR BANDS
1	HYDROGEN	CANARY YELLOW (No.309)	1 SIGNAL RED (No.537)
2	FUEL GAS	CANARY YELLOW (No.309)	NIL
3	NAPTHA	ALUMINIUM	1 SALMON PINK (No.443)
4	NITROGEN	CANARY YELLOW (No.309)	1 BLACK BAND
5	DM WATER (SS)	NIL	NIL
6	DMDS (SS)	NIL	NIL
7	TCE (SS)	NIL	NIL
8	CAUSTIC	NIL	NIL
9	SOUR GAS	CANARY YELLOW (No.309)	2 SIGNAL RED (No.537)
10	CAUSTIC		

11	FIRE WATER	FIRE RED (No.536)	NIL
12	COOLING WATER	SEA GREEN (No.217)	NIL
13	SOUR WATER	ALUMINIUM	4 BRILLIANT GREEN (No.221)
14	15 KG STEAM	ALUMINIUM	2 SIGNAL RED (No.537)
15	5/7 KG STEAM	ALUMINIUM	3 SIGNAL RED (No.537)
16	3.5 KG STEAM	ALUMINIUM	4 SIGNAL RED (No.537)
17	1.0 KG STEAM	ALUMINIUM	5 SIGNAL RED (No.537)
18	FLARE	ALUMINIUM	CANARY YELLOW (No.309)
19	INSTRUMENT AIR	AIR CARFT BLUE (No.108)	NIL
20	PLANT AIR	ORIENT BLUE (No.174)	NIL

I. OTHER EQUIPMENT: ⚠

S. No.	SERVICE	NEW COLOUR CODE
1.	SAFETY VALVE	YELLOW
2.	PUMPS(EXCEPT WATER) AND COMPRESSORS	ALUMINIUM
3.	MOTORS	BUS GREEN
4.	TURBINES & HIGH TEMP. PUPMPS	HEAT RESITANT ALUMINIUM
5.	STRUCTURES (GENERAL)	SMOKE GREY
7.	HAND RAILING/CAGE	ORANGE
9.	EMERGENCY LIGHT FITTINGS	FIRE RED
10.	FLARE LINES OUTSIDE PLANT LIMIT	CANARY YELLOW (NO. 309)
10.	COOLERS • SHELL and SHELL COVER • CHANNEL BOX	 ALUMINIUM SEA GREEN
11.	VESSELS INCLUDING KOD	ALUMINIUM (Color band: As per individual service band width = 200 mm at the center of the vessel.

11. STANDARD COLOR CODING FOR STORAGE TANKS: ⚠

SR. NO.	DESRIPTION OF PRODUCT TANKS	GROUND COLOUR	COLOUR BANDS
1	CRUDE OIL	ALUMINIUM	TURQUOISE BLUE (No. 102)
2	SLOPS	ALUMINIUM	BLACK
3	WAXY	INSULATED	NIL
4	MTBE	ALUMINIUM	MIDDLE STONE (No.362)
5	HEXANE	ALUMINIUM	SALMON PINK (No.443)
6	BENZENE	ALUMINIUM	WHITE
7	TOLUENE	ALUMINIUM	WHITE
8	SBP	ALUMINIUM	SALMON PINK (No.443)
9	ATF	ALUMINIUM	ORIENT BLUE (No.174)
10	MOTOR SPIRIT	ALUMINIUM	SALMON PINK (No.443)
11	NAPTHA	ALUMINIUM	SALMON PINK (No.443)
12	MINERAL TURPENTINE	ALUMINIUM	ORIENT BLUE (No.174)
13	HSD	ALUMINIUM	LIGHT BUFF (No.358)
14	FLUSHING OIL	ALUMINIUM	LIGHT BUFF (No.358)
15	LDO	ALUMINIUM	LIGHT BUFF (No.358)
16	LSHS	INSULATED	NIL
17	KEROSENE	ALUMINIUM	ORIENT BLUE (No.174)
18	BITUMEN	ALUMINIUM	Insulated
19	SR, LR, HGO	INSULATED	NIL
20	FO, CYCLE OIL	ALUMINIUM	BLACK
21	REFORMATE	ALUMINIUM	SALMON PINK (No.443)
22	CAUSTIC TANKS	WHITE	NIL
24	METHANOL	ALUMINIUM	WHITE
25	EXTRACT	ALUMINIUM	WHITE
26	SULFOLENE	ALUMINIUM	INTERNATIONAL ORANGE (No.592)
27	LUBE OIL (NON-INSULATED TANKS)	ALUMINIUM	ORIENT BLUE (No.174)
28	LUBE OIL (INSULATED TANKS)	INSULATED	NIL
29	DRINKING WATER	ALUMINIUM	BRILLIANT GREEN (No.221)
30	DM WATER	ALUMINIUM	BRILLIANT GREEN (No.221)
31	RAW WATER	ALUMINIUM	BRILLIANT GREEN (No.221)
32	SALT WATER	ALUMINIUM	BRILLIANT GREEN (No.221)

Note : Band height shall be as per existing.

12. 0 PAINTING SYSTEM FOR TANKS

Surface Preparation Cu Slag blasting Sa 2.5 **Primer / Paint – Nos. of coats X DFT (Microns)**

SR NO	TANK SERVICE	TANK EXTERNAL (NOTE 2, 3) △11	TANK INTERNAL							UNDERSIDE OF BOTTOM PLATES	REMARKS, IF ANY
			BOTTOM PLATE & 1ST SHELL COURSE UP TO 1 M FROM BOTTOM. △11	ROOF LEG & ROOF DRAIN PIPES	TOP SHELL COURSE OF EXTERNAL FLOATING ROOF TANK △11	TOP SHELL COURSE OF FIXED ROOF OR INTERNAL FLOATING ROOF TANK (NOTE 5) △11	COMPLETE TANK	ROOF UNDERSIDE OF FIXED ROOF, EXTERNAL FLOATING ROOF & INTERNAL FLOATING ROOF (NOTE 1) △11	TRUSSES OF FIXED ROOF TANK AND TOP SIDE OF INTERNAL FLOATING ROOF		
1	Crude oil tanks										
			FOR CRUDE OIL TANKS REFER POINT NO. 13 WHICH IS IN LINE WITH AE-S-5431, REV-0 **AND BASED ON COMMENTS RECEIVED**. △11								

SR NO	TANK SERVICE	TANK EXTERNAL (NOTE 2, 3) ⚠	TANK INTERNAL							UNDERSIDE OF BOTTOM PLATES	REMARKS, IF ANY
			BOTTOM PLATE & 1ST SHELL COURSE UP TO 1 M FROM BOTTOM. ⚠	ROOF LEG & ROOF DRAIN PIPES	TOP SHELL COURSE OF EXTERNAL FLOATING ROOF TANK ⚠	TOP SHELL COURSE OF FIXED ROOF OR INTERNAL FLOATING ROOF TANK (NOTE 5) ⚠	COMPLETE TANK	ROOF UNDERSIDE OF FIXED ROOF, EXTERNAL FLOATING ROOF & INTERNAL FLOATING ROOF (NOTE 1) ⚠	TRUSSES OF FIXED ROOF TANK AND TOP SIDE OF INTERNAL FLOATING ROOF		
2	Hexane , Motor spirit, Naphtha, IBP 60, Kerosene, Mineral turpentine , HSD, Flushing oil, LDO, ATF components (floating roof tank), SBP, Reformate		Amine adduct cured epoxy holding primer-1x60 Epoxy based Tank Liner-(amine cured) 2x120	Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner-(amine cured) 2x120	Epoxy Coal Tar Paint-2x100	Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner-(amine cured) 2x120		Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner(amine cured) -2x120	Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner(amine cured) -2x120	Epoxy Coal Tar Paint-2x100	

SR NO	TANK SERVICE	TANK EXTERNAL (NOTE 2, 3) ⚠	TANK INTERNAL							UNDERSIDE OF BOTTOM PLATES	REMARKS, IF ANY
			BOTTOM PLATE & 1ST SHELL COURSE UP TO 1 M FROM BOTTOM. ⚠	ROOF LEG & ROOF DRAIN PIPES	TOP SHELL COURSE OF EXTERNAL FLOATING ROOF TANK ⚠	TOP SHELL COURSE OF FIXED ROOF OR INTERNAL FLOATING ROOF TANK (NOTE 5) ⚠	COMPLETE TANK	ROOF UNDERSIDE OF FIXED ROOF, EXTERNAL FLOATING ROOF & INTERNAL FLOATING ROOF (NOTE 1) ⚠	TRUSSES OF FIXED ROOF TANK AND TOP SIDE OF INTERNAL FLOATING ROOF		
3	ATF Batch (Fixed roof tanks)						Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner-(amine cured)-2x120	Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner-(amine cured)-2x120	Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner-(amine cured)-2x120	Epoxy Coal Tar Paint-2x100	

SR NO	TANK SERVICE	TANK EXTERNAL (NOTE 2, 3) ⚠	TANK INTERNAL							UNDERSIDE OF BOTTOM PLATES	REMARKS, IF ANY
			BOTTOM PLATE & 1ST SHELL COURSE UP TO 1 M FROM BOTTOM. ⚠	ROOF LEG & ROOF DRAIN PIPES	TOP SHELL COURSE OF EXTERNAL FLOATING ROOF TANK ⚠	TOP SHELL COURSE OF FIXED ROOF OR INTERNAL FLOATING ROOF TANK (NOTE 5) ⚠	COMPLETE TANK	ROOF UNDERSIDE OF FIXED ROOF, EXTERNAL FLOATING ROOF & INTERNAL FLOATING ROOF (NOTE 1) ⚠	TRUSSES OF FIXED ROOF TANK AND TOP SIDE OF INTERNAL FLOATING ROOF		
4	Slops and effluent tanks		Amine adduct cured epoxy holding primer-1x60 Epoxy Glass Flake (Amine Adduct)-1x200	Amine adduct cured epoxy holding primer-1x60 Epoxy Glass Flake (Amine Adduct)-1x200	Epoxy Coal Tar Paint-2x100	Amine adduct cured epoxy holding primer-1x70 Epoxy Glass Flake (Amine Adduct)-1x200		Amine adduct cured epoxy holding primer-1x60 Epoxy Glass Flake (Amine Adduct)-1x200	Amine adduct cured epoxy holding primer-1x60 Epoxy Glass Flake (Amine Adduct)-1x200	Epoxy Coal Tar Paint-2x100	
5	Bitumen, SR					Two component high solid High temperature (up to 200 deg c)		Two component high solid High temperature (up to 200 deg c)	Two component high solid High temperature (up to 200 deg c)	Cold spray Aluminium OR Engineered	

SR NO	TANK SERVICE	TANK EXTERNAL (NOTE 2, 3) ⚠	TANK INTERNAL							UNDERSIDE OF BOTTOM PLATES	REMARKS, IF ANY
			BOTTOM PLATE & 1ST SHELL COURSE UP TO 1 M FROM BOTTOM. ⚠	ROOF LEG & ROOF DRAIN PIPES	TOP SHELL COURSE OF EXTERNAL FLOATING ROOF TANK ⚠	TOP SHELL COURSE OF FIXED ROOF OR INTERNAL FLOATING ROOF TANK (NOTE 5) ⚠	COMPLETE TANK	ROOF UNDERSIDE OF FIXED ROOF, EXTERNAL FLOATING ROOF & INTERNAL FLOATING ROOF (NOTE 1) ⚠	TRUSSES OF FIXED ROOF TANK AND TOP SIDE OF INTERNAL FLOATING ROOF		
						phenolic epoxy coating.-2x100 microns		phenolic epoxy coating.-2x100 microns	phenolic epoxy coating.-2x100 microns	Polysiloxane coating 2x125 microns	
6	MTBE (Methyl-Tertiary Butyl Ether) tanks		Amine adduct cured epoxy holding primer-1x60; Epoxy Based Tank Liner-(amine cured)-2x120	Amine adduct cured epoxy holding primer-1x60; Epoxy Based Tank Liner-(amine cured)-2x120	Epoxy Coal Tar Paint-2x100	Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner-(amine cured)-2x120		Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner-(amine cured)-2x120	Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner-(amine cured)-2x120	Epoxy Coal Tar Paint-2x100	

SR NO	TANK SERVICE	TANK EXTERNAL (NOTE 2, 3) ⚠	TANK INTERNAL							UNDERSIDE OF BOTTOM PLATES	REMARKS, IF ANY
			BOTTOM PLATE & 1ST SHELL COURSE UP TO 1 M FROM BOTTOM. ⚠	ROOF LEG & ROOF DRAIN PIPES	TOP SHELL COURSE OF EXTERNAL FLOATING ROOF TANK ⚠	TOP SHELL COURSE OF FIXED ROOF OR INTERNAL FLOATING ROOF TANK (NOTE 5) ⚠	COMPLETE TANK	ROOF UNDERSIDE OF FIXED ROOF, EXTERNAL FLOATING ROOF & INTERNAL FLOATING ROOF (NOTE 1) ⚠	TRUSSES OF FIXED ROOF TANK AND TOP SIDE OF INTERNAL FLOATING ROOF		
7	Caustic tanks						Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner-(amine cured)-2x120	Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner-(amine cured)-2x120	Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner-(amine cured)-2x120	Epoxy Coal Tar Paint-2x100	
8	LR, Waxy, HGO, Fuel oil, cycle oil, LSHS, Lube waxy		Amine adduct cured epoxy holding primer-1x60 Two			Amine adduct cured epoxy holding primer-1x60		Amine adduct cured epoxy holding primer-1x60 Two	Amine adduct cured epoxy holding primer-1x60 Two component	Epoxy Coal Tar Paint-2x100	

SR NO	TANK SERVICE	TANK EXTERNAL (NOTE 2, 3) ⚠	TANK INTERNAL							UNDERSIDE OF BOTTOM PLATES	REMARKS, IF ANY
			BOTTOM PLATE & 1ST SHELL COURSE UP TO 1 M FROM BOTTOM. ⚠	ROOF LEG & ROOF DRAIN PIPES	TOP SHELL COURSE OF EXTERNAL FLOATING ROOF TANK ⚠	TOP SHELL COURSE OF FIXED ROOF OR INTERNAL FLOATING ROOF TANK (NOTE 5) ⚠	COMPLETE TANK	ROOF UNDERSIDE OF FIXED ROOF, EXTERNAL FLOATING ROOF & INTERNAL FLOATING ROOF (NOTE 1) ⚠	TRUSSES OF FIXED ROOF TANK AND TOP SIDE OF INTERNAL FLOATING ROOF		
	tanks (operating immersed heat temperature 120 deg C)		component high solid High temperature phenolic epoxy coating.- 2x100 microns			Two component high solid High temperature phenolic epoxy coating.- 2x100 mic.		component high solid High temperature phenolic epoxy coating.- 2x100 microns	high solid High temperature phenolic epoxy coating.- 2x100 microns		
9	Benzene, Toluene, Methanol, Extract,			Amine adduct cured epoxy holding primer-1x60			Amine adduct cured epoxy holding primer-	Amine adduct cured epoxy holding primer-1x60	Amine adduct cured epoxy holding primer-1x60 Two	Epoxy Coal Tar Paint- 2x100	

SR NO	TANK SERVICE	TANK EXTERNAL (NOTE 2, 3) ⚠	TANK INTERNAL							UNDERSIDE OF BOTTOM PLATES	REMARKS, IF ANY
			BOTTOM PLATE & 1ST SHELL COURSE UP TO 1 M FROM BOTTOM. ⚠	ROOF LEG & ROOF DRAIN PIPES	TOP SHELL COURSE OF EXTERNAL FLOATING ROOF TANK ⚠	TOP SHELL COURSE OF FIXED ROOF OR INTERNAL FLOATING ROOF TANK (NOTE 5) ⚠	COMPLETE TANK	ROOF UNDERSIDE OF FIXED ROOF, EXTERNAL FLOATING ROOF & INTERNAL FLOATING ROOF (NOTE 1) ⚠	TRUSSES OF FIXED ROOF TANK AND TOP SIDE OF INTERNAL FLOATING ROOF		
				Two component high solid High temperature phenolic epoxy coating.- 2x100 microns			1x60 Two component high solid High phenolic epoxy coating.- 2x100 microns	Two component high solid High phenolic epoxy coating.- 2x100 microns	component high solid High temperature phenolic epoxy coating.- 2x100 microns		
10	Lube oil tanks (Non-waxy tanks)		Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner- (amine cured)-			Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner- (amine cured)- 2x120		Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner- (amine cured)-	Amine adduct cured epoxy holding primer-1x60 Epoxy Based Tank Liner- (amine cured)-2x120	Epoxy Coal Tar Paint- 2x100	

SR NO	TANK SERVICE	TANK EXTERNAL (NOTE 2, 3) ⚠	TANK INTERNAL							UNDERSIDE OF BOTTOM PLATES	REMARKS, IF ANY
			BOTTOM PLATE & 1ST SHELL COURSE UP TO 1 M FROM BOTTOM. ⚠	ROOF LEG & ROOF DRAIN PIPES	TOP SHELL COURSE OF EXTERNAL FLOATING ROOF TANK ⚠	TOP SHELL COURSE OF FIXED ROOF OR INTERNAL FLOATING ROOF TANK (NOTE 5) ⚠	COMPLETE TANK	ROOF UNDERSIDE OF FIXED ROOF, EXTERNAL FLOATING ROOF & INTERNAL FLOATING ROOF (NOTE 1) ⚠	TRUSSES OF FIXED ROOF TANK AND TOP SIDE OF INTERNAL FLOATING ROOF		
			2x120					2x120			
11	Drinking water, DM water, Raw water, Salt water			Amine adduct cured epoxy holding primer-1x60 Solvent free epoxy 1X300-(amine cured) (**Portable water Cert.**			Amine adduct cured epoxy holding primer-1x60 Solvent free epoxy 1X300-(amine cured) (**Portable water Cert.**	Amine adduct cured epoxy holding primer-1x60 Solvent free epoxy 1X300-(amine cured) (**Portable water Cert.**	Amine adduct cured epoxy holding primer-1x60 Solvent free epoxy 1X300-(amine cured) (**Portable water Cert.**	Epoxy Coal Tar Paint-2x100	

SR NO	TANK SERVICE	TANK EXTERNAL (NOTE 2, 3) ⚠	TANK INTERNAL							UNDERSIDE OF BOTTOM PLATES	REMARKS, IF ANY
			BOTTOM PLATE & 1ST SHELL COURSE UP TO 1 M FROM BOTTOM. ⚠	ROOF LEG & ROOF DRAIN PIPES	TOP SHELL COURSE OF EXTERNAL FLOATING ROOF TANK ⚠	TOP SHELL COURSE OF FIXED ROOF OR INTERNAL FLOATING ROOF TANK (NOTE 5) ⚠	COMPLETE TANK	ROOF UNDERSIDE OF FIXED ROOF, EXTERNAL FLOATING ROOF & INTERNAL FLOATING ROOF (NOTE 1) ⚠	TRUSSES OF FIXED ROOF TANK AND TOP SIDE OF INTERNAL FLOATING ROOF		
12	Sulfolene						Amine adduct cured epoxy holding primer-1x60. Amine adduct cured HB epoxy -2x120	Amine adduct cured epoxy holding primer-1x60. Amine adduct cured HB epoxy -2x120	Amine adduct cured epoxy holding primer-1x60. Amine adduct cured HB epoxy -2x120	Epoxy Coal Tar Paint-2x100	

Note: ⚠

1) Carbon steel external and internal floating roof underside paint shall cover all wetted surfaces.
2) Vertical band on shell external at gauging pole shall have top coat in black colour.
3) External painting other than crude tanks:

a) FOR UN-INSULATED TANKS EXTERNAL SURFACES - NEW OR HEAVILY CORRODED; TOP SIDE (NON-WTTED SURFACES) OF EXTERNAL FLOATING ROOF. SURFACE PREPARATION TO SA 2.5.

i) One coat of inorganic zinc ethyl silicate 1x70 microns
ii) Two coat of epoxy high solids MIO 2 X 125 microns DFT.
iii) Two coats of aliphatic acrylic polyurethane - 2 x 40 microns DFT.

b) FOR UN-INSULATED TANK EXTERNAL OF MODERATELY CORRODED OLD TANKS. SURFACE PREPARATION MANUAL CLEANING TO ST 2 OR POWER TOOL CLEANING TO ST3.

i) Tank bottom shell course shall be painted with 2x100 microns Coal Tar Epoxy paint.
ii) Other than bottom shells, Epoxy Red Oxide Zinc Phosphate Primer-1X60 and Oil Based Aluminum Paint-2 X 20**.**

c) FOR INSULATED TANK EXTERNAL OF NEW TANKS OR HEAVILY CORRODED TANKS. SURFACE PREPARATION TO SA 2.5.

i) Two component high solid High temperature (up to 200deg c dry heat) Phenolic CUI (corrosion under insulation) epoxy coating 2 X 125 microns.

d) FOR INSULATED TANK EXTERNAL OF MODERATELY CORRODED OLD TANKS. SURFACE PREPARATION MANUAL CLEANING TO ST 2 OR POWER TOOL CLEANING TO ST3.

i) Zinc dust graphite-2 x40 microns.

4) All carbon steel pontoons internal surfaces of external floating roof and internal floating roof tanks other than crude tanks:
   a) Epoxy Red Oxide Zinc Phosphate Primer-1X60 microns.
   b) Oil Based Aluminum Paint-2X20 microns.
5) External floating roof tanks top shell internal painting shall extend up to 100 mm above top of shunt of secondary seal marked at safe filling height during hydro test.
6) Aluminum surfaces shall not to be painted.
7) Before changing of tank service resistivity of the painting system to be verified.
8) In tank history details of paint manufactures with brand name to be mentioned. These would facilitate defects observations and would also be basis for evaluation of the painting contractor /paint system and manufacturer for future works.

9) For all internal lining / internal painting works, manufacturer's laboratory test statement / Laboratory Paint performance certificates to be submitted by paint manufacturers & checked apart from material test certificates for specified services at operating temperature and condition. Material shall be procured from only those approved manufacturers who will meet the above stated criteria.
10) For details of tanks internal painting refer Annexure - H

13. CRUDE OIL TANKS PAINTINGS ⚠

13.1 Scope

This standard exclusively covers the painting of crude oil storage tanks in BPCL Refineries. This standard has been derived from existing AE-S-5430, Rev. 0 and painting practices being followed at BPCL-KR. Intent of this standard is to cover a common painting practice across all BPCL group of Refineries.

13.2 Tank operating condtions

Operating temperature : Not above 65 degree celsius.
Operating pressure : Ambient.

13.3 Surface preparation

The purpose of surface preparation is to create a continuous highly adherent, homogeneous and defect free paint film with an even thickness over the tank surfaces. For new painting, **all the internal & external surfaces shall be blasted to achieve the surface profile as given in Annexure – A.** ⚠ Light shades and streaks are not allowed. When steel shot is used, it shall be used together with steel grit. The purpose of surface preparation is to create a continuous highly adherent, homogeneous and defect free paint film with an even thickness over the tank surface. Compressed air used shall be free of moisture and oil. Adequate separators and traps shall be provided, installed in the coolest part of the system. The presence of oil and water shall be determined at least two (2) times per eight hours and following every compressor start-up. The air discharge temperature shall not exceed 100 °C. The blasting nozzles should be venturi style with tungsten carbide or boron carbide as the materials for liners. Blasting nozzles shall be replaced when the specified minimum blast pressure, surface cleanliness and surface roughness can no longer be achieved. Blasting equipment and the equipment being blasted shall be properly earthed to prevent the occurrence of electrostatic discharges. If possible vacuum collector shall be installed for collecting the abrasives for recycling. Recycled shot shall be used only after ensuring that it is clean enough to provide the minimum surface preparation mentioned above.

When working in confined spaces, adequate ventilation and intrinsically safe lighting shall be used. As a minimum, ventilation shall ensure sufficient air changes such that the threshold limit value (TLV) of the various coating materials in use shall not be exceeded. Access for coating work should be constructed so as to provide easy and sufficient access for surface preparation, painting and inspection of all surfaces

13.4 Recommended environment conditions for Paint Application

For all cases, paint manufacturer guidelines shall be followed. Following restrictions are given as recommended practices:

13.4.1 Coating application shall not be permitted in the following conditions.

4.1.1 During fog, mist or rain.

4.1.2 When the relative humidity is 85 percent or above.

4.1.3 When the steel surface temperature and/or ambient temperature is below 10°C (50°F) .

4.1.4 When the steel surface temperature and/or ambient temperature is above 50°C (120°F).

4.1.5 When the steel surface temperature is less than 3°C (5°F) above the dew point.

13.4.2 For all internal painting work, the dehumidification of the surrounding air dew point shall be maintained 5 degree celsius below the prevailing surface temperature. The relative humidity shall be maintained not more than 45% from preparation to curing of coatings.

13.4.3 The measurement of the following shall ensured prior to start of work and shall be done every three hours for the entire duration of the painting work and shall extend till the paint is dried and cured.

4.3.1 Relative Humidity (RH).

4.3.2 Ambient air temperature.

4.3.3 Surface temperature of the object being painted.

4.3.4 Air temperature at surrounding of the painting.

4.3.5 Air flow

13.4.4 There shall be no welding activity or radiography testing on the shell during and after installation of coating system.

13.4.5 Humidity and dew point readings shall be taken with a sling Psychrometric meter and calculated using psychrometric tables.

13.4.6 Coatings shall not be applied before the surface has been inspected and the preparatory work approved.

13.4.7 All edges shall be ground to a minimum radius of 3.2 mm. Flame cut areas and weld spatter shall have been ground flush. All rough welds shall be ground to remove sharp edges and other such irregularities. The amount of grinding performed shall be judicious and performed only to the extent necessary to prepare the weld surface and surrounding metal surfaces in accordance with the specification. Over grinding, which would result in decreasing the wall thickness or the integrity of the weld beyond the limitations imposed by good welding practices, applicable welding codes, or tank or vessel ratings, shall be avoided. All weld spatter and arc strikes must be removed. (Refer NACE SP 0178).

13.4.8 Salt water spray areas shall require fresh water blasting or fresh water (Max. Chloride content 50 ppm) mopping to remove the salts deposited on metal surface before application of primer. Mopping can be repeated before application of other coats to remove salts deposited on previous coats, if such deposits are suspected.

13.4.9 Blast cleaned steel surfaces shall not be touched by bare hands

13.4.10 If the surface being cleaned is adjacent to a coated surface, the blast cleaning shall cut in to the coated surface by at least 50 mm. The edges of the existing coating system shall be feathered. The remainder of the existing coated surface shall be properly protected with shields or screens to prevent any over blast damage.

13.4.11 To prevent dust and abrasive contamination, blast cleaning shall not be carried out adjacent to painting operations or wet (painted) surfaces

13.5 Mixing and Painting

13.5.1 Mixing & Thinning

All paint spraying equipment, including mixers, shall be thoroughly cleaned before mixing of new materials. All coating materials shall be mixed and thoroughly stirred in accordance with the instructions of the paint Manufacturer. Sufficient agitation to maintain good mixing shall be applied until the product is used. If air is entrapped in the product during mixing/stirring, sufficient time should be allowed for the air bubbles to escape before application.

13.5.2 Application of paint/primer:

5.2.1 Blast cleaned surface shall be coated with one complete application of primer as soon as practicable but in no case later than 4 hrs. the same day or as per the time frame stipulated in the technical data sheet of the paint, whichever is earlier.

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

5.2.3 No coat shall be applied until the preceding coat has dried and cured as recommended by Paint Manufacturer. Next coat shall be applied within the time stipulated by the paint manufacturer. Before over coating, over-runs, drips and smears shall be removed and any coating damage or imperfection shall be repaired. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum specified for it as a first coat; if it exceeds the paint material has possibly deteriorated or mixing is faulty.

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

drier shall be added to paint on the job unless specifically called for in the manufacturer's specification for the paint. Paint shall be protected from rain, condensation and contamination until dry.

5.2.5 All paints and painting materials shall be stored only in rooms to be arranged by contractor and approved by Engineer-in-charge for the purpose. All necessary precautions shall be taken to prevent fire.

5.2.6 Surface preparation and paint application shall be done in presence of Manufacturer's representative. Manufacturer's representative shall have necessary certification from agency like NACE to supervise and ensure the quality of paint applied.

5.2.7 All personnel shall be provided with personnel protection, e.g. protective clothing, safety glasses, safety shoes, hard hats, goggles, respirators, earplugs, fresh air-fed hood and any other necessary safety equipment. All safety equipment shall be maintained in a good working condition. Warning signs shall be prominently displayed at all access points to areas where abrasive blasting and painting is in progress.

5.2.8 The Contractor shall protect all equipment, structures and any other areas from mechanical damage, environmental damage, blockage or obstruction and damage caused by over blasting, dripping paint, paint splashes and overspray.

5.2.9 To minimise the risk of damage, no lifting, transportation, erection or fabrication operations shall be done before the paint has been fully dried and/or cured.

5.2.10 Abrasive blast cleaning and coating operations should be carried out during daylight hours. However, grit blasting and coating may be carried out at night providing the lighting and environmental conditions are acceptable. Minimum lighting requirements for abrasive blasting, painting and inspection are 500 lux.

5.2.11 For internal tank coatings and the external coatings of buried or immersed equipment and structures, pinhole testing for electrically non-conductive coatings shall be carried out in accordance with NACE SP0188. The high voltage technique shall be used; nominally set at 5 V/µbased on DFT, or as agreed with the paint Manufacturer but not exceeding 25 kV in total. For coating thickness < 500 µ DFT, the low voltage wet sponge technique shall be used.

13.5.3 Spray application

Spraying is the required method of application. The painting Contractor shall supply the required range of spray tips, sizes and fan angles for the work being undertaken. The spray pressure shall be uniform and the spray pattern smooth.

13.5.4 Brush application

Brush application may be done for Maintenance operations, in those cases where spray application may affect other plant, equipment, property or personnel in or near the work site. Where the coating product is specified as only being suitable for brush application. Manufacturer shall confirm in writing that paint is suitable for brush application and will able to meet the guarantee period. Brush application shall be done only with concurrence of Engineer in charge. Coatings applied by brush shall be smooth and even

13.5.5 Roller application

Roller application shall only be allowed for steel floors and for panels and equipment inside climate-controlled areas. Rollers shall be of good quality to ensure uniformity of the applied coating.

13.5.6 Stripe coat

Before spray application of each coat, irregular surfaces such as sharp edges, welds, small brackets, interstices etc. shall be stripe-coated, usually by brush, to ensure the specified film thickness is provided..

13.5.7 Repair of coating defects

Damaged areas, defects in the coating system such as over-runs, drips and smears that have to be removed or areas with inadequate dry film coating thickness shall be re-cleaned. The re-cleaning shall carry over on to the sound coating for not less than 50 mm all round, the edges of which shall be feathered.

After the surface cleaning, the specified coating system shall be re-applied. Any additional coats shall blend in with the final coating at adjoining areas. Paint Manufacturers shall be consulted if the existing coating requires abrading before over-coating to obtain good bonding.

13.5.8 Only thinners specified by the paint Manufacturer shall be used

13.6 Paint Procurement

Painting Contractor shall procure paint material from BPCL approved manufacturers only.

13.7 Inspection and testing

13.7.1 Refer section 12 for testing of paint material

13.7.2 Minimum suggested stages of inspection shall be:

a. Surface Preparation
b. Primer application
c. Each coat of paint

13.7.3 All defects noticed during stages of inspection, shall be rectified free of cost by the contractor. All records shall be kept by the contractor.

13.7.4 Wet film thickness measurements shall be made throughout the course of painting in order to ascertain the adequacy and uniformity of thickness. The readings shall be taken at least one every ten (10) square metres.

13.7.5 Dry film thickness shall be taken on each coat after drying and curing of the coat. Dry film thickness (DFT) readings shall be taken using a non-destructive dry film thickness instrument capable of storing the readings. Sufficient readings shall be taken covering each coat prior to application of the following coat to ensure the correct required DFT.

13.7.6 The DFT indicated against each system shall be obtained by applying one or more coat of the paint based on paint properties. The Contractor is responsible to obtain the indicated DFT as per painting system specification.

13.7.7 DFT meter used shall be calibrated before each inspection and shall be witnessed by the Inspector. It is the duty of the Inspector to satisfy him/herself with the performance of the DFT meter.

13.7.8 Criteria for acceptance of painting work shall be in accordance with table – 2.

TABLE - 2

Test	Standard	Frequency	Acceptance criteria
Surface cleanliness	ISO 8501-1	One per ten (10) square meters	Sa 2 ½
Surface Profile	ISO 8503-2	One per ten (10) square meters	As per coating procedure / data sheet
Total Soluble salt ⚠ contamination	ISO 8502-9	One per twenty (20) square meters or minimum 5 tests whichever is more.	$<5\mu g/cm^2$
Dust	ISO 8502-3	One per ten (10) square meters	Rating 2 or better
Adhesion	ISO 4624	One pretest panel, per shift	5 MPa
Holiday Detection	NACE SP0188	100% of surface	Zero defects
Dry Film Thickness ⚠	SSPC PA-2	As per Annexure - F	Shall not be less than 80 % and more than 120 % of the Specified dry film thickness.

Test	Standard	Frequency	Acceptance criteria
			(DFT).
Wet Film Thickness	ISO 2802	One per ten (10) square meters	Consistent with providing required DFT

13.8 Painting Contrator's Responsibility

13.8.1 Contractor shall mobilize the adequate capacity dehumidification unit at site for all internal painting work, if required. The surrounding air dew point shall be maintained 5 degree celsius below the prevailing surface temperature. The relative humidity shall be maintained not more than 45% from preparation to curing of coatings.

13.8.2 The contractor shall ensure proper functioning of the dehumidification unit, measuring RH and temperature , measuring air flows and maintained 24 hours till coating work is completed in the tank.

13.8.3 All paints and consumables for a particular tank painting work shall be sourced from one manufacturer only to have desired paint performance, guarantee and single point responsibility.

13.8.4 Painting contractor shall deploy adequate number of NACE CIP Level 2 qualified coating Inspectors to supervise, monitor, inspect & control entire painting process right from the surface preparation, storage, handling, mixing and application on substrate of the painting/coating and to ensure the compliance of this specification.These qualified painting inspectors will report to and shall get guided by BPCL Inspection Dept.

13.8.5 Each contractor shall possess relevant standards and deploy all inspection tool/instrument to carry out the all above inspection and testing as per relevant standard.

13.8.6 Organising of testing all the painting parameters , supply of all the testing instruments, consumables for testing each parameter as defined in clause 7.10 above , including getting accepted by BPCL, shall be the responsibility of painting contractor.

13.8.7 The Inspection test plan which will be mandatory part of the contract shall be prepared by the above qualified coating inspector and get it approved by BPCL inspection department. The Contractor's qualified coating inspector and BPCL shall sign an inspection report as per approved inspection test plan.

13.8.8 The report shall consist, as a minimum, of the following in addition to the inspection parameters and acceptable criteria :

8.8.1 Names of the applicator and the responsible personnel.

8.8.2 Dates when work was carried out.

8.8.3 Paint testing parameters tested

8.8.4 Equipment and techniques used.
8.8.5 Type and calibration of instruments used.
8.8.6 Weather and ambient conditions.

13.9 Frequency and Guarantee of painting

13.9.1 Frequency of Crude oil tanks Painting system for both internal and external painting shall be once in 10 years.

13.9.2 Painting Contractor shall furnish Guarantee for minimum 10 years for both internal and external painting with shot blasting as per Annexure – B, C, D & E.

13.9.3 BPCL reserves the right to invoke the gurantees in case contractor (paint applicator) or contractor fail to repair the paint failed area within reasonable time.

13.10 Painting system

13.10.1 The painting system shall be as mentioned in Annexure – A.
13.10.2 The bands and colour coding shall be proved as per Specific Refinery Location practices .
13.10.3 No painting is considered for roof legs. Roof legs to be hot dip galvanized. Schedule 80 pipes to be used for both roof legs and sleeves. The sufficient clearance shall be ensured between sleeves and roof legs.

13.11 SIGN WRITING

All painting work information shall be mentioned (sign writing) with date of completion on Tank shell as per Engineer-in-charge instructions.

13.12 INSPECTION AND TESTING OF PAINTING MATERIAL

13.12.1 All the procured paint material along with batch/test certificates shall be offered for BPCL inspection for approval. Remaining Shelf life shall be at least 90% of the total duration at the inspection above.

13.12.2 All paint materials shall be accompanied by Manufacturer Test Certificate. Inspection Engineer at his discretion may test paint formulations, if required.

ANNEXURE – A

SR. NO.	SURFACES	SURFACE PREPARATION	SURFACE PROFILE	PRIMER	FINISH COAT	TOTAL DFT, MICRONS
1	Bottom plate under side (soil side)	Blast cleaning with grit and shot to Sa 2.5	Profile of 40-70 microns	Not applicable	Polyamine cured epoxy-2x150 microns DFT. OR Epoxy Coal Tar Paint-2x100	300
2	a) Bottom plate top side (oil side). b) Bottom first shell internal up to 1.0 m from bottom. c) Floating roof underside (oil side) d) Pontoon rims external (oil side) e) Roof legs	Blast cleaning with grit and shot to Sa 2.5	Sharp angular profile of 40 -70 microns	Amine adduct cured epoxy - 1x75 microns DFT. OR Phenolic epoxy novolac holding primer - 1x75 microns DFT.	Polyamine adduct cured solvent free epoxy - 2x275 microns DFT. OR Phenolic epoxy novolac solvent free epoxy- 1x550 microns DFT.	625
3	Top shell internal 100 mm above top of shunt of secondary seal marked at safe filling height during hydro test.	Blast cleaning with grit and shot to Sa 2.5	40 microns	Epoxy Coal Tar Paint-1x100 microns. --- OR One coat of inorganic zinc ethyl silicate (VS 65%; 85% zinc on dry film minimum) – 1x70 microns DFT.	Epoxy Coal Tar Paint-1x100 microns --- OR 1) Two coat of epoxy high solids MIO (minimum 50 % lamellar MIO on dry film and	200 OR 350

SR. NO.	SURFACES	SURFACE PREPARATION	SURFACE PROFILE	PRIMER	FINISH COAT	TOTAL DFT, MICRONS
					vol solids - 80%). Mist coat & full coat 100 microns plus one coat 100 microns DFT. 2) Two coats of aliphatic acrylic polyuretha ne with minimum 55% vol solids - 2 x 40 microns DFT. (Black color) **OR** 1) Two coats of modified epoxy (vol solids -80%). Mist coat & full coat 100 microns plus one coat 100 microns DFT. 2)Two coats of aliphatic acrylic polyurethane with minimum 55% vol solids - 2 x 40 microns DFT. (Black color).	

SR. NO.	SURFACES	SURFACE PREPARATION	SURFACE PROFILE	PRIMER	FINISH COAT	TOTAL DFT, MICRONS
4	a) Bottom shell external surface. b) Vertical gauging band.	Cu-Slag to Sa 2.5	40 microns	One coat of inorganic zinc ethyl silicate (VS 65%; 85% zinc on dry film minimum) – 1x70 microns DFT.	1) Two coat of epoxy high solids MIO (minimum 50 % lamellar MIO on dry film and vol solids - 80%). Mist coat & full coat 125 microns plus one coat 125 microns DFT. 2) Two coats of aliphatic acrylic polyuretha ne with minimum 55% vol solids - 2 x 40 microns DFT. (Black color) OR 1) Two coats of modified epoxy (vol solids -80%). Mist coat & full coat 125 microns plus one coat 125 microns DFT. 2)Two coats of aliphatic	400

SR. NO.	SURFACES	SURFACE PREPARATION	SURFACE PROFILE	PRIMER	FINISH COAT	TOTAL DFT, MICRONS
					acrylic polyurethane with minimum 55% vol solids - 2 x 40 microns DFT. (Black color).	
5	a) Shell external surface other than bottom shell and vertical gauge band. _____ b) Roof deck plates top surface	Cu-Slag to Sa 2.5 ⚠ _____ Blast cleaning with grit and shot to Sa 2.5	40 microns	One coat of inorganic zinc ethyl silicate (VS 65%; 85% zinc on dry film minimum) – 1x70 microns DFT.	1) Two coat of epoxy high solids MIO (minimum 50 % lamellar MIO on dry film and vol solids - 80%). Mist coat & full coat 125 microns plus one coat 125 microns DFT. 2) Two coats of aliphatic acrylic polyurethane with minimum 55% vol solids - 2 x 40 microns DFT. (Aluminium finish, RAL 9006 white aluminium)	400

SR. NO.	SURFACES	SURFACE PREPARATION	SURFACE PROFILE	PRIMER	FINISH COAT	TOTAL DFT, MICRONS
					OR 1) Two coats of modified epoxy (vol solids -80%). Mist coat & full coat 125 microns plus one coat 125 microns DFT. 2)Two coats of aliphatic acrylic polyurethane with minimum 55% vol solids - 2 x 40 microns DFT. (Aluminium finish, RAL 9006 white aluminium).	
6	Pontoon inside surface	SSPC – SP2/ST2	Not applicable	Not applicable	Epoxy Red Oxide Zinc Phosphate Primer-1X60 microns. Oil Based Aluminum Paint-2X20 microns.	100
7	Color band	Light surface preparation with emery paper 200 no. on painted surface.		Not applicable	Two coats of aliphatic acrylic polyurethane with minimum 55% vol solids 2 x 30 mic.	60 (above painted surface.)

SR. NO.	SURFACES	SURFACE PREPARATION	SURFACE PROFILE	PRIMER	FINISH COAT	TOTAL DFT, MICRONS
8	Logo/ sign writing	Light surface preparation with emery paper 200 no. on painted surface.		Not applicable	Alkyd base enamel paint in two coats of 30 microns per coat total two coats.	60 (above painted surface.)

Note: 1) Stripe coat is must for weld area, edges and corners.
2) Over zinc silicate, intermediate coat to be applied in mist coat and full coat technique.
3) In PU paint of silver shade, total thickness to be build in two coats.
4) For PU paint QUVA 340 requirement of 80 % gloss retention after 3000 hrs.
5) All sharp edges to be grinded well before painting.
6) Pitted area having width greater than 2mm or depth greater than 5 mm to be filled with solvent less polyamine adduct cured epoxy.

ANNEXURE – B

PAINT PERFORMANCE GUARANTEE REQUIREMENTS

a) In order to ensure that BPCL gets proper value for the amount invested in painting system, all endeavour should be to entrust the painting job in totality to the paint manufacturers/ paint applicators approved by paint manufacturer..

b) The contractor/ paint manufacturers shall guarantee that the chemical and physical properties of paint materials used are in accordance with specifications contained herein.

c) Any defects that occur during the guaranteed life for the paint system either due to improper paint materials used or due to faulty application shall be rectified by the paint manufacturer/contractor at no extra cost to BPCL.

d) **For surfaces painted after shot and grit blasting** ⚠ **-** The bank guarantee for initial 2 years from the date of completion of the job and 8 years Corporate guarantee in the required format (enclosed) for the tank painting system shall be submitted by paint manufacturer & applicator either prior to taking up the painting job or after the completion of painting job subject to release of payment only after the submission of this guarantee.

e) For surfaces painted after Cu Slag blasting - The bank guarantee for initial 2 years from the date of completion of the job and 3 years Corporate guarantee in the required format (enclosed) for the tank painting system shall be submitted by paint manufacturer & applicator either prior to taking up the painting job or after the completion of painting job subject to release of payment only after the submission of this guarantee. ⚠

f) The performance guarantee consists of 2 years bank guarantee for an equivalent value of 20% and balance **3 years** ⚠ and 8 years against corporate guarantee.

ANNEXURE – C

1. All the guarantees should be submitted to BPCL in the Standard format given in this specification. The guarantee will be two components.

   i. The performance guarantee shall be given by the painting contractor for the period of two years. The retention period is for two years from the date of completion. Hence, Bank guarantee for 2 years for an amount equal to 20 % of contract value of painting work to be submitted to BPCL.

   ii. **Corporate guarantee for balance 8 years for surfaces painted after Shot and grit blasting and 3 years for surfaces painted after Cu Slag blasting.** ⚠ The painting contractor and paint manufacturer should have proper agreements and both should sign the corporate guarantee.

2. During the guarantee period, the paint supplier will carry out joint inspection every **six months for first two years and every one year after this** along with BPCL engineers. All repairs during the guarantee period will be done by paint manufacturers at their cost. The extent of corrosion will be monitored during joint inspections by paint supplier and BPCL engineer.

3. High pressure water washing for tank internal to be carried out .The water shall be potable.

4. Dehumidification system shall be used for internal painting of tanks, if required. Paint Manufacturer shall decide on whether dehumidifier is there based on the atmospheric condition..

ANNEXURE – D

PROFORMA OF BANK GUARANTEE
(PERFORMANCE)

Bharat Petroleum Corporation Limited

Dear Sirs,

In consideration of the Bharat Petroleum Corporation Limited (hereinafter called 'the Company' which expression shall include its successors and assigns) having awarded to M/s. (Name)_____

(Constitution)_____(address) _____ _____herein after referred to as ' The Vendor' which expression shall wherever the subject or context so permits include its successors and assigns) a supply contract in terms inter alia, of the Company's Letter no. _____ dated_____ and the General Purchase Conditions of the Company and upon the conditions of Vendor's furnishing security for the performance of Vendor's obligations and / or discharge of the Vendor's liability under and/or in connection with the said supply contract up to a sum of (in figures) _____(in words) _____only amounting to 20% (twenty percent) of the total contract value.

We, (name) _____ (constitution)_____ _____(hereinafter called 'the Bank' which expression shall include its successors and assigns) hereby jointly and severally undertake and guarantee to pay to the Company in (Currency) forthwith on demand in writing and without protest or demur of any and all moneys anywise payable by the Supplier to the Company under, in respect of or in connection with the said supply contract inclusive of all the Company's losses and expenses and other moneys anywise payable in respect of the above as specified in any notice of demand made by the Company to the Bank with reference to this Guarantee upon an aggregate limit of Rs. (in figures)_____(in words) _____ only).

And the Bank hereby agrees with the Company that:

a) This Guarantee I Undertake shall be a continuing Guarantee and shall remain valid and irrevocable for all claims 'of the Company and liabilities of the Vendor arising upto and until midnight of _____.

b) The Guarantee / Undertaking shall be in addition to any other guarantee or security of whatsoever that the Company may now or at any time otherwise have in relation to the Vendor's obligations / liabilities under and / or in connection with the said supply contract, and the Company shall have full authority to take recourse to or reinforce this security in preference to the other security(ies) at its sole discretion, and no failure on the part of the Company in enforcing or requiring enforcement of any other security shall have the effect of releasing the Bank from its full liability hereunder.

c) The Company shall be at liability without reference to the Bank and without effecting the full liability of the Bank hereunder to take any other security in respect of the Vendor's obligations and / or liabilities under or in connection with the said supply contract and to vary the terms vis-a-vis the vendor of the said supply contract or to grant time and / or indulgence to the Vendor or to reduce or to increase or otherwise vary the prices of the total contract value or to release or to forbear from enforcement all or any of the obligations of the Vendor under the said supply contract and / or the remedies of the Company under any other security (ies) now or hereafter held by the Company and no such delaying(s), variation(s), reduction(s), increase(s) or other indulgence/s or arrangement/s with the Vendor or release or forbearance whatsoever shall have the effect of releasing the Bank from its full liability to the Company hereunder or of prejudicing rights of the Company against the Bank.

d) This Guarantee / Undertaking shall not be determined by the liquidation or winding up, dissolution or change of constitution of insolvency of the Vendor but shall in all respects and for all purposes be binding and operative until payment of all moneys payable to the Company in terms hereof.

e) The Bank hereby waives all rights at any time inconsistent with the terms of the Guarantee / Undertaking and the. obligations or the Bank in terms hereof shall not be anywise affected or suspended by reason of any dispute or disputes having been raised by the Vendor (whether or not pending before any Arbitrator Officer, Tribunal or Court) or any denial of liability by the Vendor or any other order of communication whatsoever by the Vendor stopping or preventing or purporting to stop or prevent any payment by the Bank to the Company in terms hereof.

f) The amount stated in any notice of demand addressed by the Company to the Guarantor as liable to be paid to the Company by the Vendor or as suffered or incurred by the Company on account of any losses or damages or costs, charges and / or expenses shall as between the Bank and the Company be conclusive of the amount so liable to be paid to the Company or suffered or incurred by the Company, as the case may be, and payable by the Guarantor to Company in terms hereof.

Signed for and on behalf of: _____

Name of Bank : _____

Address : _____

Seal of the bank : _____

ANNEXURE - E

CORPORATE GUARANTEE IN THE FORM OF INDEMNITY BOND FOR 120 (ONE HUNDRED TWENTY) MONTHS FOR PAINTING WORKS (To be executed in Rs.100/- stamp paper)

(To be executed by Paint manufacturer/applicator)

To,
M/s. Bharat Petroleum Corporation Ltd
_____

Sub: Agreement No. _____

The Indemnity Bond/Undertaking/Guarantee Bond executed at _____ this _____ day of the month _____ of _____ by M/S. _____ (Name of Paint Supplier/applicator) called the "Guarantor" (which expression shall mean and include, if the context so admits, the partners or partner for time being of the firms & their or their prospective heirs, executors, administrators, successors and assigns in law) in favour of:

M/s. BHARAT PETROLEUM CORPORATION LTD, having its registered office at Bharat Bhavan, 4&6, Currimbhoy Road, Ballard Estate, Mumbai-400001, hereafter called the "OWNER"(which expression shall include its administrators, successors and assigns in Law).

Whereas the "OWNER" desirous of having executed painting works specified in the Agreement No. _____ dated _____ issued by the "OWNER" on the successful tenderer who had participated in the tender No_____ invited by the "OWNER" and opened on _____ has caused drawings specifications and bill of quantities showing and describing the work to be done and the same have been signed on behalf of the successful tenderer.

WHEREAS the successful tenderer have agreed with the "OWNER" to execute and perform the said work specified in the work order upon terms and conditions provided in the Agreement executed.

'AND WHEREAS the paint manufacturer has fully acquainted himself and understood all the terms and conditions attaching to the agreement entered into between the 'OWNER' and successful tenderer regarding execution and performance of the works specified in the Agreement aforementioned".

IT IS, THEREFORE, THE INTENT OF THIS INDEMNITY BOND BY THE "GUARANTOR" jointly and severally to indemnify and keep indemnified the "owner" as stated hereinafter:

1.0 Frame work and purpose of this contract

This contract defines what constitutes a defect in the coating system and what are the rights, obligations and liabilities of the parties in case of defect.

1. The Guarantee

a. The "GUARANTOR" hereby confirms having carefully examined the coating system supplied by the "OWNER" in the tender document. Considering all technical aspects & climatic conditions prevailing at the location, the "GUARANTOR" confirm that specified coating system are fully suitable for the desired services on mild steel vertical oil storage tanks, steel structures and steel pipelines etc. at the location.

b. The " Paint supplier/ Applicator" hereby confirms that they will ensure thorough surface preparation as per specified Swedish Standards so as to have desired surface profile before application of paint system on the steel surface.

c. The "GUARANTOR" hereby agrees to provide all latest codes, SSPC guidelines for painting, providing surface profile comparators, wet & dry film thickness measuring gadgets and other painting inspection kits for inspection by "OWNER" conforming to latest SSPC guidelines for painting inspection.

d. The " Paint supplier/ Applicator hereby confirms to provide Dry Film Thickness (DFT) of paint specified for every coat .If, actual DFT of a particular coat is beyond the permissible limits of acceptance of variation in DFT, the "GUARANTOR" undertakes to blast the painted surface again and apply paint system so as to achieve the specified DFT for every coat.

e. The "GUARANTOR" hereby confirms that the coating system will be free from the defects i.e. chalking, cracking, alligatoring, flaking, peeling delamination, rusting, blistering, wrinkling, edge failure and failure around welds etc. during the Guarantee period of the coating system. The Guarantors guarantee the performance of the coating system during the Guarantee period.

f. "Performance" means that there will be no defective areas of the coating system during the Guarantee period.

g. The "GUARANTOR"(Paint supplier/ Applicator) hereby agree that guarantee period of coating system will commence on the completion of work as detailed in the Agreement No. _____ dated _____. This corporate guarantee shall commence on

completion of retention period of two years from the date of completion of work. (The Painting Contractor shall provide Bank Guarantee for the first two years from the date of completion). It expires 8 (Eight) Years after commencement of corporate guarantee period. However, the "OWNER' agrees that guarantee period shall not be extended by any repairs or repainting made during this guarantee period.

h. "Defective Areas" mean an area or areas where spontaneous visible corrosion has broken the paint film to a degree exceeding Rust grade No.6 (1% or more of the area painted) of SSPC Visual Standard No.2 (Guide to Standard method of evaluating Degree of rusting on painted steel surfaces), within the Guarantee period and or where softening of paint and or peeling of paint is noticed. Irrespective of the paint in other respects, such as but not limited to staining, loss of gloss on an area is not considered defective when corrosion activity is rust grade No.6 or less during the said Guarantee period :

i. The " Paint supplier/ Applicator (GUARANTOR) hereby confirms that in case of premature paint failure attributable to the quality of the paint, this Guarantee covers that the Guarantor will supply paint free of cost and will repaint/rectify free of cost for those areas (defective) where premature paint failure has been accepted and is attributable to the quality of paint and or workmanship.

1. EXCLUSIONS/Force Majure

The "GUARANTOR" shall have no liability under this contract for the following:

a. Deterioration and damage to the painting system not caused by wear and tear but by Welding or other heating, Mechanical action, Fire, Explosion, unusual action of the elements or any other occurrence outside the Guarantor control, and loss or damage which is a consequence of the aforementioned excluded causes and occurrences.

b. Coating areas on which repair or other works have been performed by the "owner" after commencement of painting.

c. Deterioration of coating system caused by physical abuse such as on walkways, handrails, ladders etc.

d. The " Paint supplier and Applicator" obligations are automatically waived off and void if coating system are affected as consequences of strike, war, invasion, acts of terrorism, or foreign enemies, hostilities, civil war, rebellion, insurrection, military or usurped power, confiscation or Nationalization or requisition or destruction of or damage to property by or under the order of any Govt or authority and to the extent that loss or damage is directly or indirectly caused by such circumstances or natural catastrophe.

Authorized Signatory of the Paint Manufacturer/Applicator

Name of the Paint manufacturer/ Applicator : _____

Address of the Paint manufacturer/ Applicator : _____

_____

_____

Seal :

WITNESS

1.

2.

ANNEXURE – F ⚠

Procedure for Measurement of Dry Film Coating Thickness

Definitions:

DFT – Dry Film Thickness

Gauge Reading – A single DFT reading at one point

Spot – A circle of 4 cm diameter

Spot Measurement - Average of acceptable three gauge readings within a spot (circle of 4 cm diameter)

Spot Measurement Procedure:

Minimum of three (3) gauge readings shall be made for each spot measurement of either the substrate or the coating. Repeated gauge readings, even at points close together, may differ due to small surface irregularities of the coating and the substrate. For each new gauge reading move the probe to a new location within 4 cm diameter circle defining the spot. Discard any unusually high or low reading that cannot be repeated consistently. Take the average of the acceptable gauge readings as the spot measurement.

Required Number of Measurements for Conformance to a thickness specification

Number of Measurements:

Make five (5) spot measurements spaced randomly over each 10 m^2 (100 ft^2) area to be measured. No. of spot measurement beyond five for an area of 10 m^2 can be increased as decided by BPCL. The five spot measurements shall be made for each 10 m^2 (100 ft^2) of area as follows :

a. For structures not exceeding 30 m^2 (300 ft^2) in area, each 10 sq m^2 (100 ft^2) area shall be measured.

b. For structures not exceeding 100 m^2 (1000 ft^2) in area, three 10 m^2 (100 ft^2) areas shall be randomly selected and measured.

c. For structures exceeding 100 m^2 (1000 ft^2) in area, the first 10 m^2 (1000 ft^2) shall be measured as stated in (b) above and for increment thereof or each additional 100 m^2 (1000 ft^2) of area, one 10 m^2 (1000 ft^2) area shall be randomly selected and measured.

d. If the dry film thickness for any 10 m^2 (100 ft^2) area as mentioned in (b) & (c) above is not in compliance with the requirements of (e) & (f) as mentioned below, then additional measurements must be made to isolate the nonconforming area.

Specifying Thickness :

Both a maximum and a minimum DFT should be specified for the coating. If a maximum thickness value is not explicitly specified, the specified thickness shall be minimum.

e. Minimum thickness : The average of five spot measurements for each 10 m^2 (100 ft^2) area shall not be less than the specified minimum DFT. The average of three guage readings at any single spot measurement in any 10 m^2 (100 ft^2) area s hall not be less than 80% of the specified minimum DFT. If the average of five spot measurements for a given 10 m^2 (100 ft^2) area meets or exceeds the specified minimum DFT and any spot measurement does not met 80% of the specified minimum DFT , additional spot measurements may be made to define the non-conforming areas.

f. Maximum thickness : The average of five spot measurements for each 10 m^2 (100 ft^2) area shall not be more than the specified maximum DFT. No single spot measurement in any 10 m^2 (100 ft^2) area shall be more than 120% of the specified minimum DFT. If the average of the five spot measurements of a given 10 m^2 (100 ft^2) area meets or falls below the specified maximum DFT, but one or more spot measurements is more than 120% of the specified minimum DFT, additional spot measurements may be made to define the non-conforming area .

Illustration of the method.

All measurements shall be taken randomly in accordance with paragraphs (b) & (c).
This does no apply to areas ≤ 300 ft^2.

Illustration of point (a). –

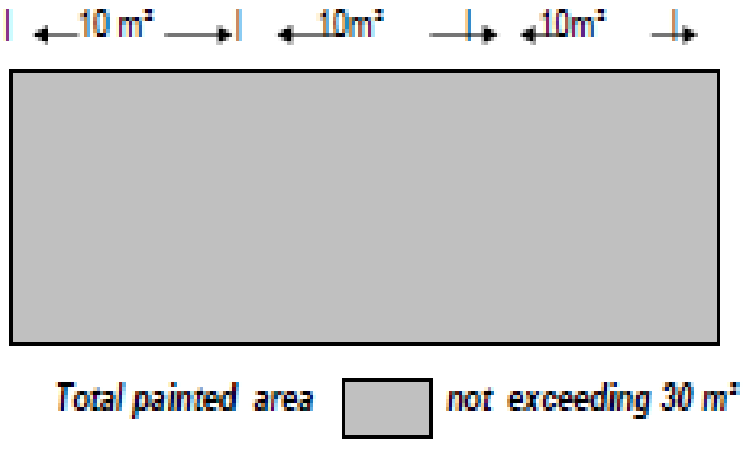


Illustration of point (b) –

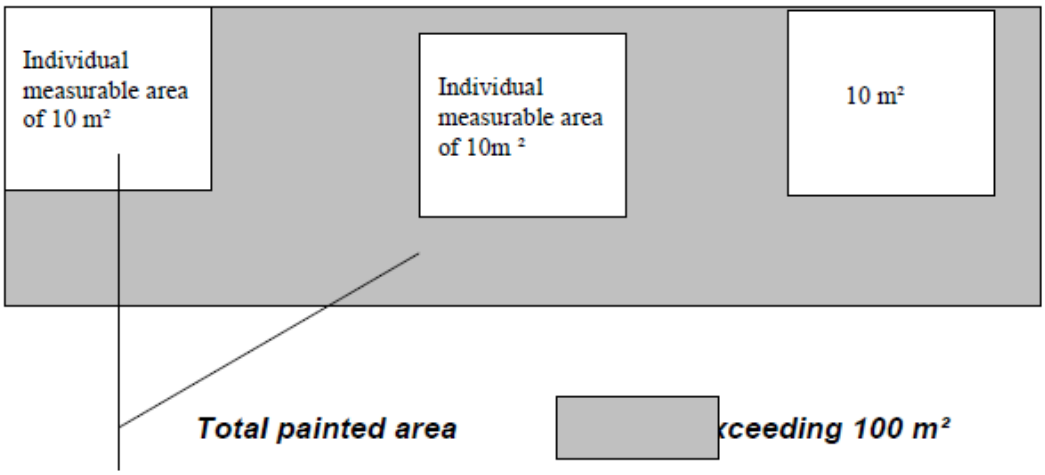
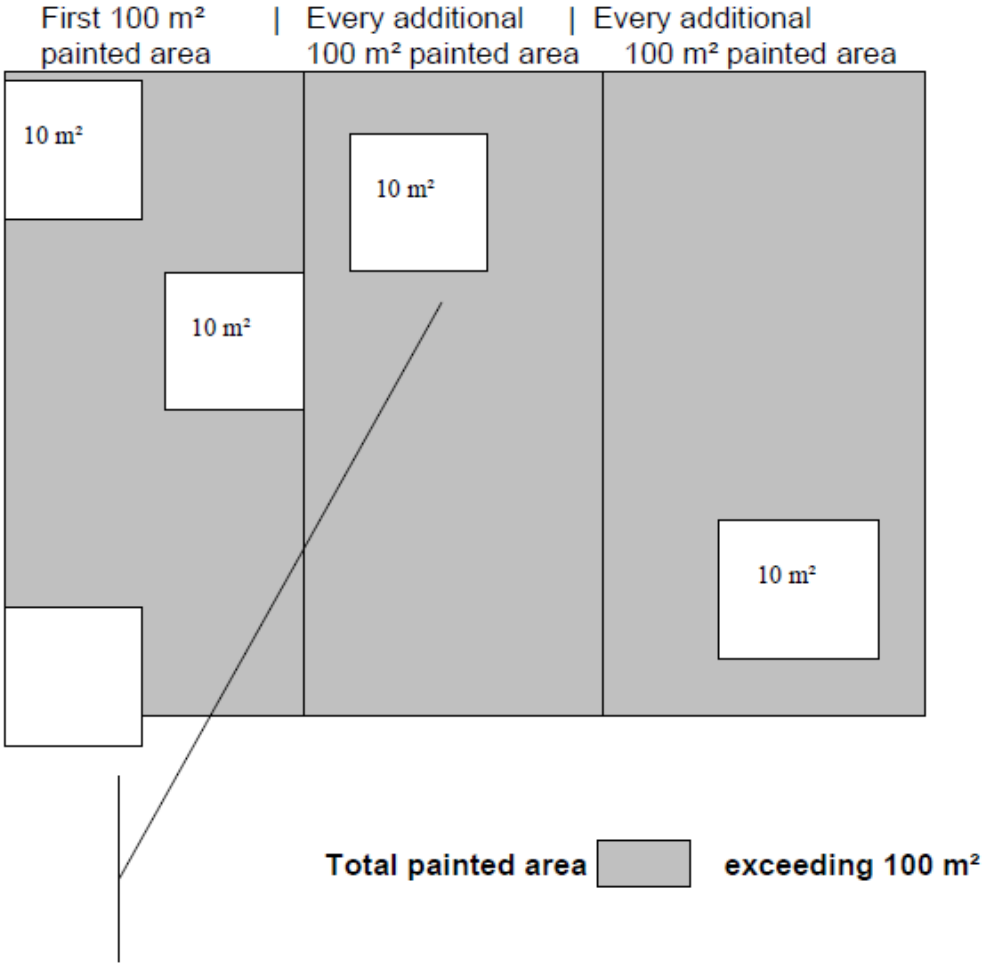


Illustration of point (c) –



Individual measurable areas of 10 m² each

Measurement of DFT Coating on Pipe line.

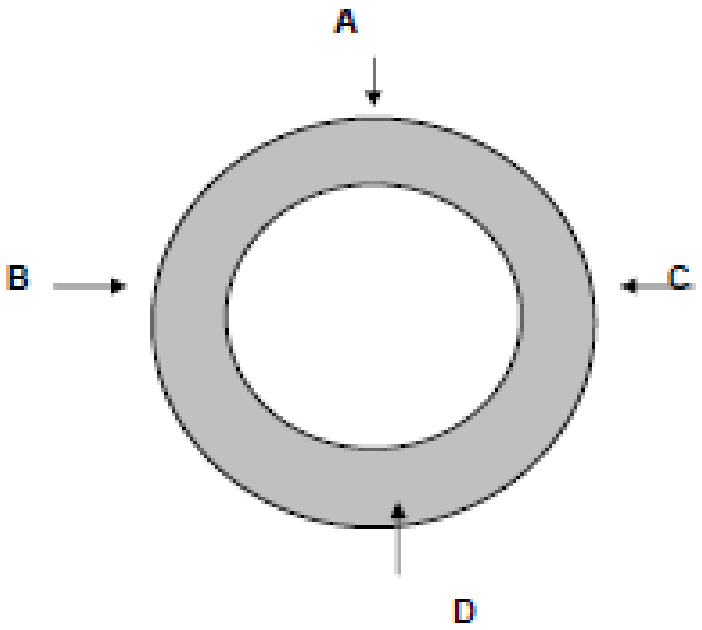
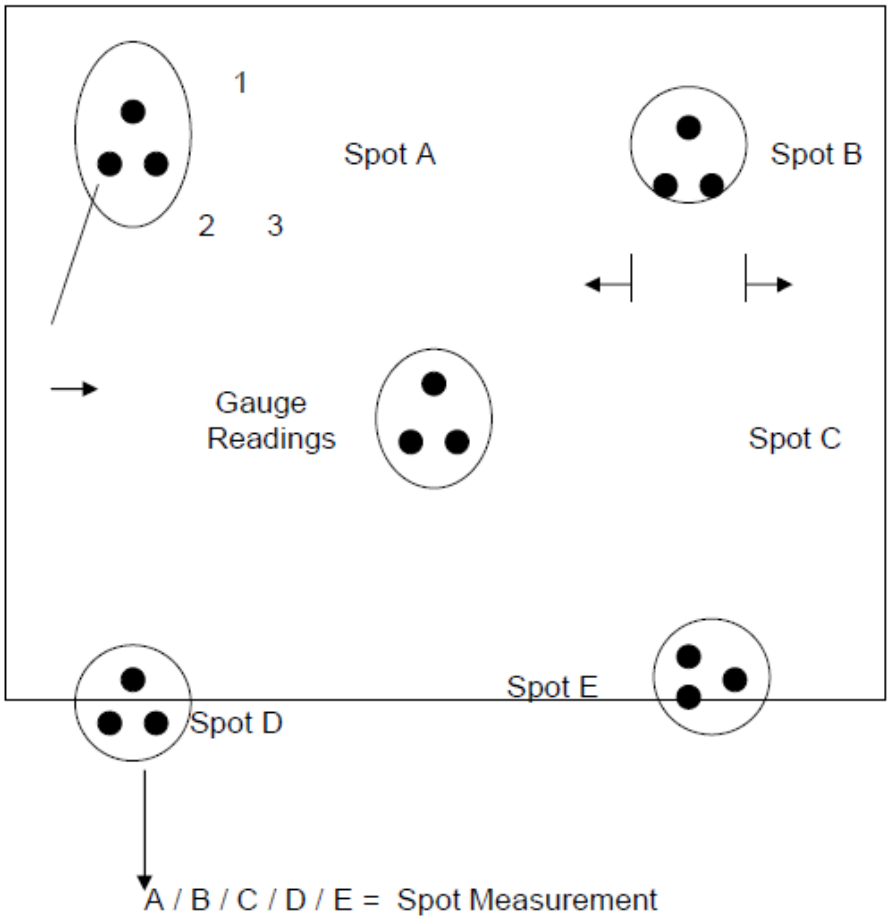


TABLE – 8

Pipe Dia. Range	Each measurable lengths	Nos. of Spot Measurements	Distance between two measurable lengths
2" – 6"	1m	4	3
8" – 14"	1m	4	5
16" – 20"	1m	4	8
22" & Above	1m	5	12

Details of spot measurement in an area of 10 m² (10 ft x 10 ft) Area .



1.5 in.

A / B / C / D / E = Spot Measurement

1 / 2 / 3 = Gauge Readings

Circle Diameter between Reading 1 / 2 / 3 = Min. 4 cm.

Reference – SSPC-PA 2 June 1, 1996

ANNEXURE – G ⚠

SPECIFICATION FOR THERMALLY SPRAYED ALUMINIUM (TSA) COATING

1.0 SCOPE:

The following sections outlines the requirement of supply, application and testing of thermally sprayed aluminum, coatings (TSAC) for corrosion protection of insulated carbon steel piping and equipments with design temperature not exceeding 540^0C.

2.0 ITEMS TO BE THERMALLY SPRAYED:

Steel Structures/equipments to be protected by TSAC shall be as per standard 3C of this standard specification. Structures, components thermally sprayed shall not have any uncoated area or shall not be in mechanically connected by flanges etc. to any uncoated bare steel work. Such adjacent areas to TSA coated areas, if not coated by TSA shall have suitable paint coating system as per the standard specification.

3.0 TSAC REQUIREMENTS:

3.1 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 (Refer Sec.6.7). 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 ISO 8502-9. Maximum allowable salt content shall be considered 50mg/m^2. (5 micrograms/cm^2). 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. Testing shall be carried out at least on each component, once per 200 m^2 and a min of 3 times per shift during progress of work.

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, Nickel slag, Garnet or Aluminum Oxide as abrasives will also be suitable having mesh size in the range of G16 to G24 (10-30 mesh), conforming to SSPC-AB-1. Mesh size shall be required as appropriate to the anchor tooth depth profile requirement and blasting equipment used. The blasted surface should be having angular profile depth not less than 65 microns with sharp angular shape but shall not exceed 85 microns. 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 - 20m^2 of blasted surface.

Surface preparation shall be completed in one abrasive blasting 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 reblasted 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 ^{0} from perpendicular to work surface. Blasting media must be free of debris, excessive fines, and contaminants such as NaCl and sulfur salts (Ref. SEC 6.0 of this Spec.). Blast cleaning shall not be performed when the surfaces to be blasted are wet or less than 5 ^{0} C above dew point temperature or when the relative humidity in the vicinity of the work is greater than 90%.

3.1.1 **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. Sec. 6.6.2 shall be used to validate clean and dry air.

3.1.2 **Feed Stock:**

The feed stock shall be in form of wire. The feed stock shall be 99.5% aluminum of commercial purity grade, its composition shall be in accordance with requirement of BS 1475 or ASTM B833 or ISO 209-1 type A 1 (wrought aluminum and aluminum alloys, wire). Wire shall be supplied in protective wrapping indicating batch number and other details.

3.1.3 **Thickness Requirement:**

The nominal thickness of finished TSAC shall be 250 microns having minimum value of 225 microns at low thickness area (valleys) and not more than 275 microns at peak areas.

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

3.1.4 **Coating Bond Strength Requirement:**

The TSAC coating shall have a minimum individual tensile-bond strength value of 1000 psi for flame sprayed and 1500 psi for arc sprayed coating with an average of 2000 psi for arc sprayed coatings. Minimum tensile bond strength should be achieved by proper anchor tooth profile of blasted surface, laying down the TSA thickness in multiple passes and carrying out TSA application under controlled environment.

3.1.5 **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.

4.0 THERMAL SPRAY APPLICATION PROCEDURE:

Items in the atmospheric zone to be coated by TSA shall be applied by either Flame spray or Arc spray method only. For coating under insulation, application shall be by arc wire method.

4.1 Equipment Set Up:

4.1.1. 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 (See 7.0 of this application).

4.1.2 **Spray Parameters:**

Spray parameters (see table - 9 below) and thickness of each crossing pass shall be set and shall be validated with bend test (See 6.5 of this Spec.).

4.1.3 **Spray Parameters:**

Spray Parameters	Method of Application	
Arc voltage	Arc wire Spray	Flame Wire Spray
	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
Coating porosity	Less than 8%	Less than 15%
Spray distance (spray Gun work place)	6-8”	5-7”
Spray Pass width	40 mm	20 mm

The above parameters to be validated with a bend test by the contractor before start of work (for details of bend test see Sec.6.5 of this Spec.).

4.2 Post Blasting Substrate Condition and Thermal Spraying Period.

4.2.1 The steel surface temperature shall be at least 5^0C above dew point of ambient air temperature.

Steel substrate surface temperature shall be recorded by with a contract pyrometer. Thermal spraying should commence within 15 minutes from the time of completion of blasting.

4.2.2 **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. If within this period rust bloom appears Sec.4.4.1 of this specification will apply.

4.3 Pre-Heating:

For flame spraying, the initial starting area of 1 - 2 square feet to be preheated to approx. 120^0 C to prevent condensation of moisture in the flame on the substrate. For arc spraying the preheating is not required.

4.4 Thermal Spraying:

Spraying should commence only after validation of equipment set up by procedure qualification test and spray parameter validation tests described in Sec 7.0 and 6.5 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 described in Sec 7.0 of this specification.

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.

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 $\pm 30^0$ from perpendicular to the substrate.

- Maintain nominal standoff distance and spray pass width as given below:

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

4.4.1 **Rust Bloom** (Visual appearance of rust or Discoloration):

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

If Rust bloom in form of discoloration, or any blastering 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 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.

4.4.2 **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).

4.4.3 **TSAC Finish:**

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

5.0 SEALER:

Sealant shall be applied after satisfactory application of TSAC and completion of all testing and measurements of the finished TSAC as per Sec 6.0 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 sealant shall be Silicone Alkyd Aluminum paint having DFT not more than 35 – 40 micron. Typically seal coast shall be applied at a spreading rate resulting in theoretical 38 microns DFT. The seal coat shall be applied in accordance with SSPC-PA 1 and the paint manufacturer instruction for sealing.

6.0 TESTING AND MEASUREMENT SCHEDULE:

6.1 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 as per ISO 8502-3 shall be used to confirm absence of dust or foreign debris on the cleaned surface. Checks shall be done on each component at least once per 200 m^2 of blasted surface and minimum of 3 checks per shift.

6.2 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 micrometer). Spot measurement shall be carried out every 15 m^2 of blasted surface. At each spot three measurements shall be taken over an area of 10 cm^2 and average of measurements to be recorded and reported. If profile is <65 microns blasting shall continue till greater than 65 microns depth profile is achieved.

6.3 TSAC Thickness (In-Process Testing for finished coating during regular production)

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

6.3.2 For flat surfaces, measurements shall be taken along a straight measurement line, one measurement line for every 15 m^2 of applied TSAC shall be selected along which 5 measurements to be taken at 25 mm internal and average to be reported.

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

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

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

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

6.4 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^2. 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 removed and reapplied.

- The tensile bond portable test instrument to be calibrated according to ASTM C 633.

6.5 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.

6.5.1 **Test Procedure:**

a) Five corrosion control steel coupons each of dimension 50 mm x 150 mm x 1.3 mm thk. to be prepared.

b) Surface shall be prepared by dry abrasive blast cleaning as per this specification.

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 180^0 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
- Only minor cracking that cannot be lifted from substrate with a knife blade.

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

6.6 Tests for blasting media, blasting air

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

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

a) 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.

b) Soluble salt contamination if suspected shall be verified by method ASTM D 4940. If present, media to be replaced.

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

6.6.2 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.

6.7 Test for presence of oil/grease and contamination

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 or residue-free dichloromethane 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.

7.0 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.

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

- Divide the sample piece into four quadrants.

- Measure thickness along the diagonal line of each quadrant.

- For 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 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 meet the specification requirement.

7.2 Bend Test: Bend test shall be carried out as detailed at Sec.6.5 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.

8.0 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.

9.0 RECORDS:

- 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, bond 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 Sec 8.0 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.

10.0 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.

11.0 SAFETY:

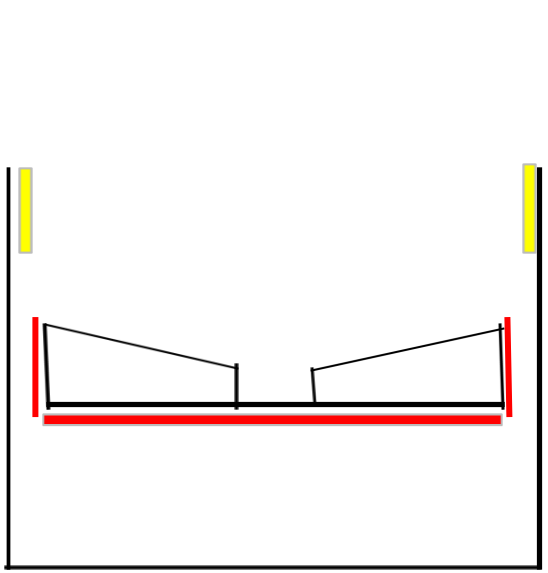
The TSAC applicator shall follow all safety procedures required by the purchaser/owner. Owner shall also give compliance requirement to be followed by applicator. The applicator shall follow all appropriate regulatory requirements.

12.0 CODES AND STANDARDS:

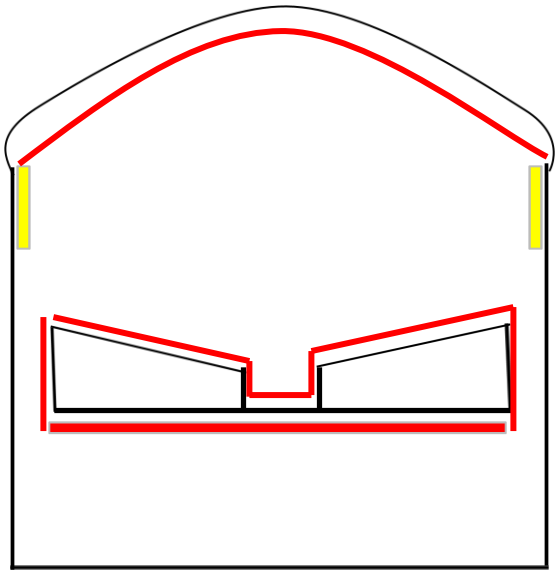
This specification shall apply in case of conflict between specification and following applicable standards:

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
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 Aluminum, Zinc and their Alloys and Composites
NACE No.12/AWS C2.23M/SSPC-CS 23.00	Specification for the application of thermal spray coatings (Metalizing) of aluminum, zinc, and their alloys and composites for the corrosion protection of steel
SSPC Publication	The inspection of coating 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

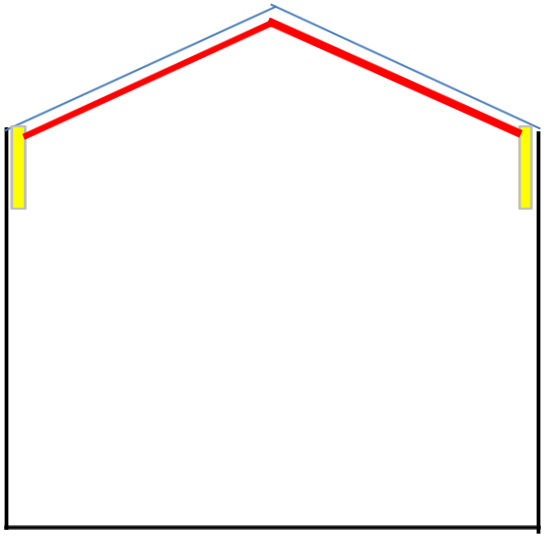
ANNEXURE – H ⚠



EXTERNAL FLOATING ROOF



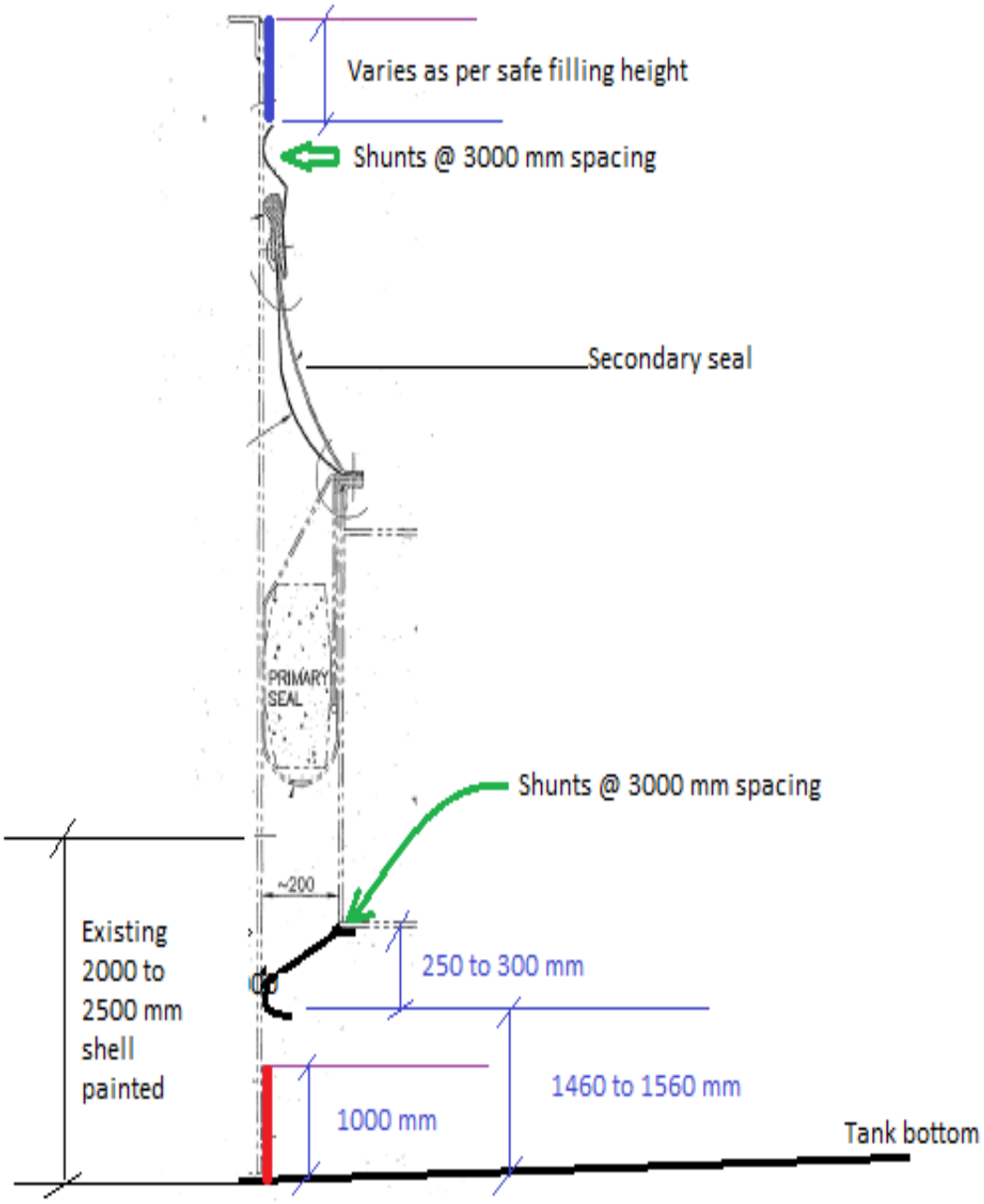
INTERNAL FLOATING ROOF



FIXED ROOF

1. **Top Shell Course of External Floating Roof tank**
2. **Top Shell Course of Internal Floating Roof tank or Fixed Roof**
3. **Roof underside of External Floating Roof & Internal Floating Roof & Fixed Roof.**
4. **Trusses of Fixed roof and top side of Internal Floating Roof.**

TANK SHELL PAINTING – INTERNAL



ANNEXURE – I ⚠

BRAND NAMES OF PAINTS:

Note: These brand names of paints are indicative; continuous change in product name shall be considered during execution. Only five vendors' brand names are mentioned herewith as indicative, however other approved vendors equivalent brands shall also be treated as accepted. In case of conflict between generic name and product name, Generic name of the paint for the specified services shall be considered final.

Table – A

BPCL SPECIFICATIONS				M/S ASIAN		M/S SIGMA	
SR. NO.	**SYSTEM**	**PRIMER**	**SPECIFIED VOL. SOLIDS**	**BRAND NAME**	**Vol. Solids %**	**BRAND NAME**	**Vol. Solids %**
1	P1	Inorganic Zinc ethyl silicate primer (Minimum 85% Zinc dust by weight in the dried film)	60 ± 2 %	Apcosil 605(85%)	65	Sigmazinc 170	65
2	P2	Epoxy red oxide zinc phosphate primer	50 ± 2 %	Apcodur EHB ZP Primer	58	Sigmacover 246	64
3	P4	Self priming surface tolerant epoxy mastic paint	80 ±2 %	Rust-O-Cap	80	Sigmacover 620	80
4	P5	Amine Adduct Cured Epoxy Holding Primer	60 ± 2 %	Apcodur CP 682	58	Not Available	
5	P6	Two Component Polyamide cured Epoxy Primer	57%±2 %	Apcodur EHB ZP Primer	58	Sigmacover 280	57
6	P7	Epoxy red oxide zinc phosphate PRIMER SUITABLE FOR GI SURFACE	50 ± 3 %	Apcodur CP 681	58	Sigmacover 280	57
		FINISH PAINTS					
7	F1	High build two pack ployamide cured epoxy	60± 2%	Asian HB Epoxy Coating	65	Sigmacover 410	80

BPCL SPECIFICATIONS				M/S ASIAN		M/S SIGMA	
SR. NO.	**SYSTEM**	**PRIMER**	**SPECIFIED VOL. SOLIDS**	**BRAND NAME**	**Vol. Solids %**	**BRAND NAME**	**Vol. Solids %**
8	F2	Low VOC High build Surface tolerant Epoxy pigmented with Al, Micaceous iron oxide	80%	Rust-O-Cap MIO	80	Not Available	-
9	F3	Epoxy glass flake paint (amine adduct -Buried Pipelines)	87 $\pm$ 3%	Apcotide 1200	85	Sigmashield 905	100
10	F4	Two pack Epoxy based **tank liner** (Amine cured) (Immersed Services For - Hexane ,Motor spirit, Naphtha, IBP 60, Kerosene, Mineral turpentine, HSD, Flushing oil,LDO, ATF, Methyl Tertiary Butyl ether, Lube Oil, **Caustic**, services.)	60 $\pm$ 2 %	Paint with Laboratory Paint performance certificates for specified services at operating temperature & condition	60	Paint with Laboratory Paint performance certificates for specified services at operating temperature & condition	60
11	F5	Two Component solvent free amine cured epoxy (Immersion services)	100%	APCOGUARD SF 722	100	Sigmaguard CSF 650	100
12	F6	Solvent Free Epoxy amine cured (Potable Water)	100%	Apcoguard SF 155	100	Sigmaguard CSF 585	100
13	F7	Epoxy coal tar paint (Immersion Grade)	64 $\pm$ 2%	Apcodur CF 655	80	Sigmacover 300	71
14	F9	Solvent free amine cured epoxy reinforced with glass flakes. (Sea Water Pipeline internal)	100	Not Available	-	Sigmashield 905	100
15	F10	Epoxy glass flake paint (amine adduct)(IMMERSION SERVICES)	90 ± 3%	Paint with Laboratory Paint performance certificates for specified services at operating temperature & condition	100	Paint with Laboratory Paint performance certificates for specified services at operating temperature &	100

BPCL SPECIFICATIONS				M/S ASIAN		M/S SIGMA	
SR. NO.	**SYSTEM**	**PRIMER**	**SPECIFIED VOL. SOLIDS**	**BRAND NAME**	**Vol. Solids %**	**BRAND NAME**	**Vol. Solids %**
						condition	
		HIGH TEMPERATURE PAINTS					
16	T1	Boiler composition	40 ± 2 %	Apcomin Interior Boiler Composition	46	Not Available	-
17	T2	Bituminous stack black	40 ± 2 %	Asian Bituminous Coating.	50	Not Available	-
18	T3	Zinc dust graphite paint	40 ± 2 %	Not Available	-	Not Available	-
19	T4	Oleoresinous based heat resistant Aluminium paint (up to 250 deg. C)	30 ± 2 %	Asian Heat Resisting Al Paint	30	Not Available	-
20	T6	Silicone Heat resistant Aluminum paint (400 - 600 deg. C)	28 ± 2 %	Apcotherm HR 600(upto 600 Deg C)	28	Not Available	-
21	T8	Two component high solid, high temperature phenolic CUI (corrosion under insulation Epoxy coating (UP TO 200 DEG. C)	67 $\pm$ 2%	Apcotherm EPN 200	70	Sigmatherm 230	68
22	T9	Heat resistant Engineered Polysiloxane	75% $\pm$ 2%	Not Available	-	PSX-738	84
23	T10	Temperature indicating paint based upon modified silicone	42%	Not Available	-	Not Available	-

BPCL SPECIFICATIONS				M/S ASIAN		M/S SIGMA	
SR. NO.	**SYSTEM**	**PRIMER**	**SPECIFIED VOL. SOLIDS**	**BRAND NAME**	**Vol. Solids %**	**BRAND NAME**	**Vol. Solids %**
24	T11	Two component high solid High temperature **(suitable up to minimum 120 deg C. immersed heat)** phenolic epoxy coating.- 2x100 microns(IMMERSION SERVICES For - LR, Waxy, HGO,Fuel oil, cycle oil, LSHS, Lube waxy , Benzene, Toluene, Methanol, Extract, services.)	67 ± 2%	Paint with Laboratory Paint performance certificates for specified services at operating temperature & condition	67	Paint with Laboratory Paint performance certificates for specified services at operating temperature & condition	67
		POLYURETHANE PAINTS					
25	U1	Acrylic Aliphatic weather resistant polyurethane paint	50±2%	Apcothane CF 678/ Apcothane HBPU Finish	57/64	Sigmadur 550	55
		ALKYD BASED PAINT					
26	B1	Synthetic enamel paint	40 ± 2 %	Apcomin Synthetic Enamel	42	Sigmarine 48	45
27	B2	Oil based Aluminium paint	40 ± 2 %	Asian Al	40	Not Available	-

Table – A (Continued…)

BPCL SPECIFICATIONS				M/S AKZO NOBEL		M/S HEMPEL	
SR. NO.	**SYSTEM**	**PRIMER**	**SPECIFIED VOL. SOLIDS**	**BRAND NAME**	**Vol. Solids %**	**BRAND NAME**	**Vol. Solids %**
1	P1	Inorganic Zinc ethyl silicate primer (Minimum 85% Zinc dust by weight in the dried film)	60 ± 2 %	Interzinc 22	63	Galvosil 15700	65

BPCL SPECIFICATIONS				M/S AKZO NOBEL		M/S HEMPEL	
SR. NO.	**SYSTEM**	**PRIMER**	**SPECIFIED VOL. SOLIDS**	**BRAND NAME**	**Vol. Solids %**	**BRAND NAME**	**Vol. Solids %**
2	P2	Epoxy red oxide zinc phosphate primer	50 ± 2 %	Intergard 251	63	Hempadur 1530C	51
3	P4	Self priming surface tolerant epoxy mastic paint	80 ±2 %	Inteseal 547	80	Hempadur Mastic 47550	81
4	P5	Amine Adduct Cured Epoxy Holding Primer	60 ± 2 %	Interline 1012	60	Hempadur 15500	68
5	P6	Two Component Polyamide cured Epoxy Primer	57%±2 %	Intergard 251	63	Hempadur 15553	55
6	P7	Epoxy red oxide zinc phosphate PRIMER SUITABLE FOR GI SURFACE	50 ± 3 %	Intergard 269	47	Hempadur 15553	55
		FINISH PAINTS					
7	F1	High build two pack ployamide cured epoxy	60± 2%	Intergard 966	62	Hempadur Mastic 47550	81
8	F2	Low VOC High build Surface tolerant Epoxy pigmented with Al, Micaceous iron oxide	80%	Interplus 256	80	Hempadur Mastic 4588 (mixed)	80
9	F3	Epoxy glass flake paint (amine adduct -Buried Pipelines)	87 ± 3%	Interzone 505	90	Multi-Strength 35870 GF	87
10	F4	Two pack Epoxy based **tank liner** (Amine cured) (Immersed Services For - Hexane ,Motor spirit, Naphtha, IBP 60, Kerosene, Mineral turpentine, HSD, Flushing oil,LDO, ATF, Methyl Tertiary Butyl ether, Lube Oil, **Caustic**, services.)	60 ± 2 %	Paint with Laboratory Paint performance certificates for specified services at operating temperature & condition	60	Paint with Laboratory Paint performance certificates for specified services at operating temperature & condition	60

BPCL SPECIFICATIONS				M/S AKZO NOBEL		M/S HEMPEL	
SR. NO.	**SYSTEM**	**PRIMER**	**SPECIFIED VOL. SOLIDS**	**BRAND NAME**	**Vol. Solids %**	**BRAND NAME**	**Vol. Solids %**
11	F5	Two Component solvent free amine cured epoxy (Immersion services)	100%	Interline 925P	100	Multi-Strength 35530/1	100
12	F6	Solvent Free Epoxy amine cured (Potable Water)	100%	Interline 925	100	Multi-Strength 35530/1	100
13	F7	Epoxy coal tar paint (Immersion Grade)	64 $\pm$ 2%	Not Available	-	Hempadur Coaltar 15130	70
14	F9	Solvent free amine cured epoxy reinforced with glass flakes. (Sea Water Pipeline internal)	100	Interline 925 GF	100	Not Available	-
15	F10	Epoxy glass flake paint (amine adduct)(IMMERSION SERVICES)	90 ± 3%	Paint with Laboratory Paint performance certificates for specified services at operating temperature & condition	90	Paint with Laboratory Paint performance certificates for specified services at operating temperature & condition	90
		HIGH TEMPERATURE PAINTS					
16	T1	Boiler composition	40 ± 2 %	Not Available	-	Not Available	-
17	T2	Bituminous stack black	40 ± 2 %	Intertuf16	53	Hempinol 10220	50
18	T3	Zinc dust graphite paint	40 ± 2 %	Not Available	-	Not Available	-
19	T4	Oleoresinous based heat resistant Aluminium paint (up to 250 deg. C)	30 ± 2 %	Intertherm 919	25 $\pm$ 2 %	Hempel Silicon Acrylic 56940	54
20	T6	Silicone Heat resistant Aluminum paint (400 - 600 deg. C)	28 ± 2 %	Not Available	-	Hempel Silicon Aluminium 56914	43

BPCL SPECIFICATIONS				M/S AKZO NOBEL		M/S HEMPEL	
SR. NO.	**SYSTEM**	**PRIMER**	**SPECIFIED VOL. SOLIDS**	**BRAND NAME**	**Vol. Solids %**	**BRAND NAME**	**Vol. Solids %**
21	T8	Two component high solid, high temperature phenolic CUI (corrosion under insulation Epoxy coating (UP TO 200 DEG. C)	67 ± 2%	Intertherm 228	67	Hempadur 85671	68
22	T9	Heat resistant Engineered Polysiloxane	75% ± 2%	Not Available		Not Available	-
23	T10	Temperature indicating paint based upon modified silicone	42%	Intertherm 715	42	Hempel Thermo-Colour 56980	57
24	T11	Two component high solid High temperature **(suitable up to minimum 120 deg C. immersed heat)** phenolic epoxy coating.- 2x100 microns(IMMERSION SERVICES For - LR, Waxy, HGO,Fuel oil, cycle oil, LSHS, Lube waxy , Benzene, Toluene, Methanol, Extract, services.)	67 ± 2%	Paint with Laboratory Paint performance certificates for specified services at operating temperature & condition	67	Paint with Laboratory Paint performance certificates for specified services at operating temperature & condition	67
		POLYURETHANE PAINTS					
25	U1	Acrylic Aliphatic weather resistant polyurethane paint	50±2%	Interthane 138	50	Hempathane 55190	63
		ALKYD BASED PAINT					
26	B1	Synthetic enamel paint	40 ± 2 %	Interlac 826	64	Hempalin 52140	46
27	B2	Oil based Aluminium paint	40 ± 2 %	Intertherm Al	40	Hempel Al	40

Table – A (Continued…)

BPCL SPECIFICATIONS				M/S JOTUN	
SR. NO.	**SYSTEM**	**PRIMER**	**SPECIFIED VOL. SOLIDS**	**BRAND NAME**	**Vol. Solids**
1	P1	Inorganic Zinc ethyl silicate primer (Minimum 85% Zinc dust by weight in the dried film)	60 ± 2 %	Resist 86	67%
2	P2	Epoxy red oxide zinc phosphate primer	50 ± 2 %	Penguard HSP ZP	73%
3	P4	Self priming surface tolerant epoxy mastic paint	80 ±2 %	Jotamastic 80	80%
4	P5	Amine Adduct Cured Epoxy Holding Primer	60 ± 2 %	Tankguard Storage	63%
5	P6	Two Component Polyamide cured Epoxy Primer	60%±2 %	Not Available	-
6	P7	Epoxy red oxide zinc phosphate PRIMER SUITABLE FOR GI SURFACE	50 ± 3 %	Penguard Primer	51%
		FINISH PAINTS			
7	F1	High build two pack ployamide cured epoxy	60± 2%	Penguard Midcoat	82%
8	F2	Low VOC High build Surface tolerant Epoxy pigmented with Al, Micaceous iron oxide	80%	Not Available	-
9	F3	Epoxy glass flake paint (amine adduct -Buried Pipelines)	87 ± 3%	Marathon XHB	96%

BPCL SPECIFICATIONS				M/S JOTUN	
SR. NO.	**SYSTEM**	**PRIMER**	**SPECIFIED VOL. SOLIDS**	**BRAND NAME**	**Vol. Solids**
10	F4	Two pack Epoxy based **tank liner** (Amine cured) (Immersed Services For - Hexane ,Motor spirit, Naphtha, IBP 60, Kerosene, Mineral turpentine, HSD, Flushing oil,LDO, ATF, Methyl Tertiary Butyl ether, Lube Oil, **Caustic**, services.)	60 ± 2 %	Paint with Laboratory Paint performance certificates for specified services at operating temperature & condition	60
11	F5	Two Component solvent free amine cured epoxy (Immersed services)	100%	Tankguard SF	100%
12	F6	Solvent Free Epoxy amine cured (Potable Water)	100%	Tankguard DW	100%
13	F7	Epoxy coal tar paint (Immersion Grade)	64 ± 2%	Not Available	-
14	F9	Solvent free amine cured epoxy reinforced with glass flakes. (Sea Water Pipeline internal)	100	Not Available	-
15	F10	Epoxy glass flake paint (amine adduct)(IMMERSION SERVICES)	90 ± 3%	Paint with Laboratory Paint performance certificates for specified services at operating temperature & condition	96%
		HIGH TEMPERATURE PAINTS			
16	T1	Boiler composition	40 ± 2 %	Not Available	-
17	T2	Bituminous stack black	40 ± 2 %	Not Available	-

BPCL SPECIFICATIONS				M/S JOTUN	
SR. NO.	**SYSTEM**	**PRIMER**	**SPECIFIED VOL. SOLIDS**	**BRAND NAME**	**Vol. Solids**
18	T3	Zinc dust graphite paint	40 ± 2 %	Not Available	-
19	T4	Oleoresinous based heat resistant Aluminium paint (up to 250 deg. C)	30 ± 2 %	Aluminum Paint HR	45%
20	T6	Silicone Heat resistant Aluminum paint (400 - 600 deg. C)	28 ± 2 %	Solvalitt Alu.	40%
21	T8	Two component high solid, high temperature phenolic CUI (corrosion under insulation Epoxy coating (UP TO 200 DEG. C)	67 ± 2%	Epoxy HR	63%
22	T9	Heat resistant Engineered Polysiloxane	75% ± 2%	Not Available	-
23	T10	Temperature indicating paint based upon modified silicone	42%	Not Available	-
24	T11	Two component high solid High temperature **(suitable up to minimum 120 deg C. immersed heat)** phenolic epoxy coating.- 2x100 microns(IMMERSION SERVICES For - LR, Waxy, HGO,Fuel oil, cycle oil, LSHS, Lube waxy , Benzene, Toluene, Methanol, Extract, services.)	67 ± 2%	Not Available	-
		POLYURETHANE PAINTS			
25	U1	Acrylic Aliphatic weather resistant polyurethane paint	50±2%	Hardtop XP	63%
		ALKYD BASED PAINT			
26	B1	Synthetic enamel paint	40 ± 2 %	Not Available	-

BPCL SPECIFICATIONS				M/S JOTUN	
SR. NO.	**SYSTEM**	**PRIMER**	**SPECIFIED VOL. SOLIDS**	**BRAND NAME**	**Vol. Solids**
27	B2	Oil based Aluminium paint	40 ± 2 %	Not Available	-